

**ECOLOGICALLY SUSTAINABLE FISHERIES:
SOCIETY, POLITICS, BIOLOGY AND ECONOMICS IN FISHERIES
MANAGEMENT**

by

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STATEMENT OF AUTHENTICITY

This thesis contains no material which has been accepted for the award of any other higher degree or graduate diploma in any tertiary institution. To the best of my knowledge and belief, this thesis contains no material previously published or written by another person, except when due reference is made in the text of the thesis.

A handwritten signature in black ink, appearing to read 'G Phillips', written in a cursive style.

Gregory Phillips

11 November 1998

ABSTRACT

The global fisheries crisis of the 1990s has heightened concerns about ecologically sustainable management of fisheries. There is nothing new about the recent failures of particular fisheries. They fit a pattern often repeated through history. But the scale of the current crisis makes it more dramatic, and virgin stocks are no longer available to provide opportunities for expansion. To achieve sustainable fisheries in the future we need to identify and address the causes of fisheries failures. These causes may be far reaching and be integral to the social, political and economic structures of society. Meaningful solutions therefore, may only be achieved by successfully challenging established social, political and economic structures and interests. Ultimately the ecological sustainability of fisheries may depend more on the nature of the societies who use them than on particular biological considerations. Fisheries management with holistic goals that contribute to the development of a sustainable society may have greater relevance than management that focuses on biological and economic issues in isolation and without regard to wider social and political implications. Holistic management might also achieve better biological and economic outcomes in the short term. Sustainable societies are those that can contain the selfish aspirations of vested interests that would seek advantage at the expense of the well-being of present and future generations of society as a whole. Egalitarian democracy with an ability to protect the common good is therefore a prime requirement for a sustainable society. Use of fisheries resources in ways that contribute to the equalisation of wealth and power in society, therefore contributes to the development of sustainable societies. Fisheries management based on enclosure and privileged access, including many strategies using tradable quota, contributes to the consolidation of wealth and power in few hands, and regardless of short term outcomes, may undermine the long term prospects for sustainability.

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1. INTRODUCTION

1.1 THE GLOBAL FISHERY CRISIS

In the 1990s there was widespread recognition that global fisheries were in a state of crisis. Statistics gathered by the Food and Agriculture Organisation of the United Nations (FAO 1995) showed that total landings from the world's fisheries, which had increased annually since the second world war, had leveled off. In 1990, there was no growth in fisheries production, the total catch for the year fell below the reported catch for 1989, in spite of the fact that more resources were being devoted to fishing effort than ever before. Following 1990 annual landings stagnated at about 100 million tonnes for several years. Ecological "limits to growth" of the world's capture fisheries have apparently been reached. Realisation that it was no longer possible to increase the yield from fisheries, a significant part of the global economy, had serious implications for a global society committed to and structurally dependent on sustaining economic growth.

The fisheries crisis of the 1990s did not come as a complete surprise. Garcia and Newton (1994) point out that overcapacity and overfishing were recognised at the United Nations International Overfishing Conference held in London in 1946. McVay (1966) and others gave warning of the inevitability of resource collapse as a consequence of unsustainable fishing practices. Their warnings were not based on sophisticated predictive modeling techniques, but on observation of the decline and collapse of many of the world's component fisheries. As one fishery after another was harvested to economic extinction, the world's expanding fleets turned their attention to new species, stocks or regions that were being 'discovered' as a result of oceanographic or scientific research, or made economically viable as a result of the development of new technologies. The global catch continued to increase in the decades following World War II, not as a result of the implementation of sustainable fishery practices, but of the expansionist, sequential "mining" of newly discovered stocks. In a world of ecological limits this situation could not continue indefinitely. Eventually there would be no new stocks to exploit. Nevertheless, against the logic of the common good, the global fishing fleet continued to expand as nations and individuals competed in an effort to gain for their own use a greater share of the wealth of the global fishery commons while it lasted.

Concerns raised by the global fisheries crisis are providing a stimulus to develop ecologically sustainable fisheries management. There is increasing pressure on fishery managers to do a better job. Public awareness and concern about fishery issues has been

heightened, and this has increased political interest in promoting sustainability. International agreements to preserve biodiversity have implications for fisheries management, and other multinational treaties to promote sustainable practices are being developed (Crean and Symes 1996: 202-203; Holmes 1995). Market pressures to promote sustainable management are also being encouraged. The World Wide Fund For Nature for example, is developing a program of consumer education and promotion of products from sustainably managed fisheries.

While the pressure to promote ecologically sustainable development (ESD) of fisheries has intensified, there is not a clear and universally accepted understanding of what this means. There is often disagreement about the definition of ESD as discussed by Diesendorf (1997: 64-97). Values that some consider essential, are rejected by others, particularly where vested interests are threatened. There are also grey areas in the interpretation of generally accepted principles, and areas of conflict between apparently contradictory values. Given the obvious failures of many of the established practices of fishing and fishery management to achieve biologically sustainable outcomes, significant changes will be required. These changes will challenge powerful interest groups involved in fishing, and will have wider implications for the structures of power in society. The way fishery resources have been used has been a consequence of the structures and values of the societies that have used them. To change the way they are used from unsustainable to sustainable practices may ultimately be achievable only by changing the structures and values of those societies.

Total global catch statistics can convey a misleading picture of the fishery crisis. The concept of the "global fishery" is an artificial construct. It is comprised of thousands of distinct fisheries of great diversity. They may be distinguished from each other by reference to geographical location such as an ocean, lake or stream; or according to particular fish species that are targeted; or they may be distinguished according to technologies employed, or cultural identities of the people involved in the fishery. Not all fisheries are in decline. Some are sustainably managed and have continued to provide benefits to users for thousands of years. Many examples of these are inshore artisanal fisheries and traditional devolved management systems have contributed to their success (Pinkerton 1989; Crean and Symes 1996: 200). Finding ways to extend these sustainable management strategies to offshore fisheries remains a challenge.

FAO catch statistics also fail to reflect some of the deeper issues involved; social issues that embody the real meaning of the fisheries crisis and which may provide greater insight into its causes and provide a more meaningful basis upon which to build solutions, than do the numeric biological and economic models that are used as the basis for much resource management decision making.

Fisheries in crisis in the 1990s is not a new experience. In 1376 traditional fishermen of the Thames estuary felt threatened by the introduction of a new method of fishing with a three meter beam trawl referred to as a *wondyrchoun*. They petitioned Edward III to prohibit its use on the grounds that it was a threat to traditional methods of fishing on the river and caused a decline in fish (Dyson 1977: 37). The petition reads:

The great and long iron of the wondyrchoun runs so heavily and hardly over the ground when fishing that it destroys the flowers of the land below the water, and also the spat of oysters, mussels and other fish upon which the great fish are accustomed to be fed and nourished. By which instrument in many places the fishermen take such quantity of small fish that they know not what to do with them; and they feed and fat their pigs with them, to the great damage of the Commons of the Realm and the destruction of the fisheries.

Dyson (1977: 38) tells us that the petitioners were unsuccessful and the interests of "efficiency" won the day. Six hundred years later we can readily identify with this petition. It raises social issues relating to the threat that new, powerful and more "efficient" technologies can pose to the livelihoods of traditional fishermen. It also addresses the issues of abuse of the commons, overfishing, the wasteful use of fisheries products for stock feeds, and the impact that environmental damage caused by industrial fishing technologies can have on fisheries productivity. These are essentially the same issues confronting fisheries managers today.

Current fishing practices are extremely wasteful. Mace (1997: 3) cites FAO estimates that the commercial marine fisheries account for 28.7 million tonnes of bycatch and 27 million tonnes of discards each year, which amounts to about a third of landings from marine capture fisheries. McCully (1991) reports an estimated 25 million tonnes of fish is converted to fishmeal and oil primarily for use in animal feeds. Reaching the limits to growth in the global fishery does not necessarily herald global famine. There is room to greatly improve the ecological efficiency of the way fishery resources are used, and it is possible that these improvements may be achieved by practices that involve positive social outcomes, rather than the negative ones associated with contemporary practices reminiscent of those that were so damaging to the fishers of the Thames in 1376.

It is possible to use fisheries resources sustainably. There are many examples world wide of sustainably managed fisheries, and of fisheries that have been brought back from the brink of collapse, or even re-established following virtual extinction. These fisheries offer hope that solutions can be found to reverse the "persistent trend toward depletion" that besets many of the component fisheries that make up the global total.

Study of factors that contribute to these successes, particularly of the values and structure of the societies involved, may contribute to the development of models for sustainable management that may be applied more widely.

Baines (1995) points out that many successful traditional fisheries resource management systems have a social base, in contrast to "modern" systems which tend to be technically based. In recent years there has been a trend in some fisheries to use management strategies essentially based on "enclosure" to achieve conservation and economic objectives. Many management systems using individual transferable quota (ITQ) fall into this category. An ideology of conservation through the application of "property rights" is the basis of this approach, but it may be that the social consequences of enclosure undermine the social values and structures that are essential to the development of an ecologically sustainable society. Social issues have been undervalued in fisheries management which has traditionally focused on biological, and more recently, economic matters. But if there is a link between the social characteristics of a society, and how it interacts with the environment, then social issues need to receive greater emphasis if sustainable practices are to be achieved.

1.2 SOCIAL AND BIOLOGICAL INTERDEPENDENCE

Biologically oriented fishery managers are well acquainted with the concept of stock collapse or biological fishery failure, and they generally acknowledge that biological failure can have devastating social consequences, for example the severe unemployment and economic disruption in Canada's Atlantic maritime provinces discussed by Schrank (1995) in relation to the collapse of the Canadian cod fishery in the early 1990s. They may not so readily recognise that a fishery that is apparently biologically healthy and economically productive, can nevertheless represent a failure of fishery management, with equally severe consequences for communities that rely on it for material and spiritual values. Social values are essential components of the concept of ecologically sustainable development. Management regimes that compromise these values might therefore be considered failures, regardless of biological outcomes. However the importance of social values goes beyond merely satisfying them for their own sake because there is arguably a causative link between social failure and biological failure. Fishery management that fails to contribute to the development within a society of structures and values committed to an ecologically sustainable existence may progress inevitably to biological failure.

There is growing recognition of the need to adopt a more holistic approach to resource management that looks at underlying socio-cultural conditions (Pinkerton 1989; Symes 1996: 5), and to see that there is a two way interaction between society and the environment (Clay and McGoodwin 1995). Just as a healthy productive environment is

necessary to sustain a healthy society, a "healthy" social organisation is needed to promote the values essential to maintaining a healthy and productive environment. There is the need to generate within society, social and political forces with a vested interest in conservation if ecological sustainability is to be achieved.

A holistic view of a fishery as a complex relationship between society and the environment, the two components being inseparable, is a difficult concept for many fishery managers to come to terms with. Social values are often foreign to fishery managers who have traditionally considered them to be in the province of other disciplines. The purely scientific approach has tended to concentrate on mathematical models of biological and economic components of fisheries. The social sciences have been marginalised, perhaps because their acknowledgment of intangible and unquantifiable values makes it difficult to eliminate value judgement, and therefore political implications, from decision making. Because fishery management is so largely a political matter, in that it involves the allocation of resources, the political element is often obscured to protect vested interests from public discussion of the real issues involved. Economic and biological models often serve vested interests by allocating resources through mechanisms that pretend to be based on objective values such as conservation needs and economic efficiency imperatives.

1.2.1 FISHERIES VALUES

There are a great many values involved in fisheries. These include material values based on obtaining fish for trade or subsistence. They also include many non-material and spiritual values that may be associated with maintaining cultural traditions or an involvement with nature. Often different groups motivated by different values share the same resource. Individuals may also obtain a combination of values from their involvement with a fishery. For example, a fishery may be shared between aboriginal people, recreational anglers and commercial fishermen. Aboriginal people may value their involvement as a means of obtaining subsistence and of maintaining cultural traditions which hold deep spiritual significance. Recreational anglers may be maintaining their own traditions and spiritual values. Commercial fishermen may be motivated primarily by material values, however there are often non-material values relating to tradition and lifestyle attached to their involvement with the fishery as well.

Other groups also have an interest in the fishery. Consumers who purchase commercially caught fish benefit from the fishery. Financial institutions and shareholders may have invested in commercial fishing vessels and equipment and benefit from financial returns. Expenses incurred in relation to the fishery have benefits to other sectors of the economy. Government too has an interest. Taxes are levied on the expenses related to recreational fishing and on the financial throughput of the many

stages of the commercial fishery. Future generations have an interest as they will inherit the fishery in whatever state it is left to them. There is also the interest of those who may have no direct involvement in a fishery but have a general concern for maintaining environmental health and biodiversity.

With so many interested parties it is not surprising that the collapse of local fisheries can have severe social consequences. However not all groups have the same level of concern with maintaining the ecological integrity, cultural connectedness and other social components of the fishery. If the fishery collapses, the losses of those whose ongoing existence depends on it, and those with a spiritual connection to it, may be irreplaceable. Financial stakeholders on the other hand, may lose little. From their perspective, short term economic gains may be preferable to lower level, long term sustainable returns. If capital is returned quickly and profits made, little is lost if the fishery collapses through overfishing. Capital can be re-deployed and profits invested elsewhere. Indeed the failure of many managed fisheries may be explained by the fact that short term financial objectives took precedence over future productivity in management decision-making. Lip service may be paid to sustaining biological processes, but there is often a clear conflict of interest between environmental and financial interests. The political influence of financial stakeholders has often ensured that their short term interests are furthered at the expense of sustainable practices. This tendency is strengthened by the fact that the "state's" interest in the fishery is often primarily a financial one, and the "state" has often had significant influence and authority in fishery management issues.

1.2.2 POLITICS AND SUSTAINABLE FISHERIES

Leftwich (1983) defines politics as the way resources are used, produced and distributed in society. In this context fishery management has always been highly political in nature. Given the state of many of the world's fisheries, where overcapacity due to too many fishermen and too many boats, is meeting the constraints of biological limits, increasing competition between interest groups is inevitable. In this environment fishery management becomes increasingly distributional in nature and therefore it becomes increasingly political.

One thing is clear. Access to fishery resources has to be restricted if overexploitation is to be avoided. Competition over access can involve conflict between capital and labour, different ethnic groups, citizens, communities and corporate entities, and between regional interests and those of the centres of power. These conflicts of interest are seldom made explicit (Hersoug 1996: 21). Choices over how resources are distributed are the fundamentals of politics. The choices made will affect the future distribution of wealth and power. Those with the power to make these decisions can be expected to

make choices that will favour their own interests. In societies characterised by inequality in the distribution of wealth and power, which includes western capitalist societies and those in the model of the formerly totalitarian, communist states in which the state held monopoly control of capital, there will be a tendency for choices to perpetuate inequality (Leftwich 1983). However, if inequality is incompatible with a socially sustainable society, then choices that promote inequality will not contribute to sustainable outcomes in the long run, even if the immediate, localised problem of avoiding overexploitation appears to be addressed.

Achieving sustainable fisheries will require changes in the technology, the science and the politics of fisheries. Politics is fundamental to problems and solutions of sustainable fisheries because it dictates the way societies use and distribute resources. Making changes is difficult because powerful vested interests are involved. The politics of society are self-perpetuating. The structures and values of societies are both cause and consequence of how resources are used and distributed.

In forming a new fishery management paradigm, one based on the values of ESD, there are many resources that societies can draw from. There are many examples of fisheries that are sustainably managed. Much may be learned from some of these, in particular the potential for non-financial objectives to generate valuable social returns and significant secondary economic benefits while sustaining the biological components of the fishery. As discussed by Pinkerton (1989) and others, there is also potential for 'commons regimes' or resource 'co-management' to provide practical structures to promote sustainable practices and to provide a widely dispersed vested interest in ecosystem and resource conservation. This approach may offer more hope of success in achieving beneficial social outcomes and ecological sustainability than the alternative of enclosure of fishery resources. Enclosure is widely practised and promoted as a solution to overfishing but it does not guarantee incentives to promote conservation values in management objectives. It leads rather to increasing social inequality and this may undermine social cohesion and the sense of community interest that may be critical to achieving sustainability.

1.3 A DEFINITION OF ECOLOGICAL SUSTAINABILITY FOR FISHERIES

The Commonwealth Working Group on Ecologically Sustainable Development of Fisheries (Commonwealth of Australia 1991: 8-9) listed a number of values or principles that contribute to the concept of ecologically sustainable development. These were derived from the definition of sustainable development provided in the report of the World Commission on Environment and Development entitled *Our Common Future* (Commonwealth of Australia 1991: 8). They include social values that represent well-being goals for society in respect to the use of community resources. These values also

include internationally recognised obligations to the global community as formalised in treaties aimed at preserving the environment and conserving biodiversity. The principles listed in the draft report as both comprising and defining ESD are:

- *improvement in material and non-material well-being;*
- *intergenerational equity;*
- *intragenerational equity;*
- *maintenance of ecological systems and protection of bio-diversity;*
- *global ramifications, including international spillovers, international trade and international cooperation; and*
- *dealing cautiously with risk, uncertainty and irreversibility.*

Improvement in material and non-material well-being of present and future generations is what ESD is really all about. The draft report (Commonwealth of Australia 1991: 9) states:

The achievement of ecologically sustainable development is dependent upon improvements in material and non material well-being. In regard to material well-being the thrust of economic policy should be directed at achieving basic social justice objectives, in particular full and meaningful employment, whilst ensuring that the nature and scale of economic activity is constrained within limits that conserve and protect biodiversity and maintain the integrity of ecological systems and processes.

There is recognition that the stock of natural assets such as productive soils, mineral deposits, plants and animals, clean air and pure water comprise "natural capital". Activities that deplete natural capital cannot be continuously sustained. There is therefore the implication of the need to restrict resource use to the "sustainable income" that natural capital generates. Where natural capital is converted as a result of development into other forms of capital such as human-made assets, future generations could be compensated for the loss of natural capital by increased stocks of man-made assets such as infrastructure and increased intellectual knowledge (Commonwealth of Australia 1991: 10). However this should not include irreversible losses such as the extinction of species.

The report notes the inadequacy of Gross National Product as an indicator of well-being. It emphasises the need to give greater weight and recognition to qualitative improvements in community welfare and to develop better ways to measure them.

The values of *intergenerational equity, maintenance of ecological systems and biodiversity* and *dealing cautiously with risk, uncertainty and irreversibility* are closely

linked and interdependent. If future generations are to inherit a complete stock of natural assets, then the ecological systems and biodiversity that comprise that stock must be maintained, and a precautionary approach is needed to avoid risk of permanent loss where uncertainty and irreversibility are possible. Application of this principle to fisheries might, for example, require reasonable margins for error to be built into total allowable catch calculations to allow for uncertainty in the models being used.

Intragenerational equity is a key component of ecologically sustainable development. Diesendorf (1997: 71) defines ESD as "types of economic and social development which sustain the natural environment and promote social equity". Diesendorf discussed the issue of intragenerational equity in some detail and pointed out its interconnection with other ESD values, particularly the issue of community well-being. While intragenerational equity is a key value in its own right, an important theme of this study is the importance of intragenerational equity as a structural characteristic of society essential to achieving other aspects of ESD.

The global environment is a commons of sorts shared by all earth bound life. No matter what arrangements are made to share its use, the earth remains a commons to some degree, and for the well-being of all to be protected it is necessary to curb the self-interested actions of individuals. Equity means that some individuals do not have a disproportionate share of wealth and power to enable them to appropriate community resources to selfish ends while imposing greater costs on society as a whole. Equity means that other members of the community, by retaining a stake in and share of the wealth of the commons, have the incentive, and jointly the power to prevent abuse of their common property by individuals seeking selfish advantage. If, for example, a particular type of economic development entailed greater costs, as a result of environmental degradation, than its net economic benefits, then society would be better off if it did not go ahead. In a situation of equity where the benefits and costs were dispersed among the community this would be the likely outcome, even if only a few people understood the implications. However, if the benefits were to accrue to an individual with the political and economic means to influence the decision, and the costs were dispersed among an ignorant or impotent community, then the development might well go ahead.

The necessity for maintenance of intragenerational equity, both as a measure of the success of ESD in providing for community well-being, and as a social mechanism to support achievement of other ESD goals, is often overlooked. Justification for ignoring the issue of equity is provided by economic arguments that propose privatization as the solution to the tragedy of the commons. The concentration of wealth and interest in environmental resources resulting from privatization or enclosure is claimed to provide

a position where the consequences of development are borne by the developer. There are major flaws with this approach beyond the obvious questions of social ethics. We cannot solve the problems of abuse of commons simply by declaring that the community has no rights over those commons. If they have no rights they have no legitimate interests to be compromised. Since abuse by an individual who has been granted exclusive rights are presumed only to affect that individual and nobody else, such abuse may cease to be viewed as a problem and opposed by the community. This approach legitimises socially detrimental developments and is not compatible with the values or the necessary mechanisms for achieving ecologically sustainable development.

Olver, Schuter and Minns (1995) see a distinction between ecological objectives which stress conservation, and economic and social objectives which concentrate on issues of efficiency and allocation. This distinction may need to be reconsidered if a link can be made between the effect of social issues involving allocation, and the effectiveness of achieving conservation goals. Achieving ecological conservation objectives may be dependent on the social outcomes resulting from allocation. Achieving ecologically sustainable fisheries may have more to do with the holistic integration of appropriate social and conservation goals than with the "trading off" of biological against social and economic objectives.

2. BIOLOGICAL FISHERY FAILURE

2.1 INTRODUCTION

Aquatic ecosystems can be extremely complex and are generally less stable than land based systems. Wilson *et al.* (1994) suggest that fisheries biosystems are characterised by chaotic population behavior and that patterns of abundance vary unpredictably within limits. Sharp (1995) argues that random climatic conditions and other unpredictable factors cause dynamic changes in fish populations that cannot be effectively modeled, but which invalidate the traditional management basis. Dramatic changes often occur in the abundance of species from one season to another. There is usually a high level of uncertainty when dealing with the population ecology of fish, even of those species with comparatively predictable patterns of population ecology. Changes can be difficult to explain due to the complexity of interacting factors that may be involved, and it is often impossible to make accurate predictions. Populations may change in response to climatic influences such as the El Nino effect and complex ecological interactions which can include the involvement of human activities. Effective fishery management has to be able to accommodate and be responsive to the unpredictability of aquatic ecosystems as well as finding appropriate ways to manage the impacts of human activities on fishery ecosystems.

2.1.1 ENVIRONMENTAL FAILURE

Human activities and developments on land can have tremendous impacts on aquatic systems and fisheries. Hydro-electric developments, irrigation projects, pollution with fertilizers, pesticides, heavy metals and other toxic substances, coastal and riparian development and other factors can all cause severe damage to ecosystems and associated fisheries.

There are numerous examples of destruction of fisheries as a consequence of land-based developments. Pearce (1995), for example, describes how industrial and agricultural pollution, and the consequences of massive irrigation projects, are largely implicated in the collapse of the former Soviet Union fisheries of the Aral, the Black and the Caspian Seas. The collapse of these fisheries contributed significantly to the decline of the global fisheries harvest in the early 1990s. Thompson (1995) further illustrates the impact land based developments can have on offshore fisheries with the example of the profound effect of the Aswan High Dam on marine life in the Eastern Mediterranean due to a consequent withholding of the flow of nutrient rich alluviums into the sea.

Fishery managers have often had little ability to influence decisions regarding land based developments and activities. They have received the impacts of these

developments and tried to mitigate the effects using the limited tools available to them. This is discussed by Ward and Weeks (1994). They studied an oyster fishery affected by stress from upstream pollution inputs. Fishery managers responded to the declining population by imposing greater restrictions on fishermen in an effort to reduce their impact on the affected population. This is a classic example of treating the symptoms and not addressing the cause of the problem. The study highlighted the inadequacies of fisheries management based on a limited view of a fishery as a simple predator/prey interaction, a view that is often misplaced (Smith 1995). The authors suggest that the reason for the narrow approach taken by the agency professionals was their limited control over factors other than fishing effort (Ward and Weeks 1994: 106). Sustaining fisheries is first and foremost dependent on sustaining the environment that supports them. This needs to be seen as the priority in achieving ecologically sustainable fisheries, yet it is often considered to be outside the sphere of fisheries managers' influence.

The way fisheries are managed can have an indirect influence on these matters if it contributes to the development of institutions and a society better able to incorporate fisheries habitat protection more effectively into development decision making. If societies need to curb vested, short-term interests and promote wider well-being gains so that developments with environmental spill-overs that destroy fisheries are prevented; and if civic values and functional democratic institutions are required characteristics if a society is to be structurally capable of curbing vested interests and promoting the wider well-being; and if civic values and functional democratic institutions are dependent on some degree of equalisation of wealth and power in society; then fisheries management that contributes to equalisation of wealth and power contributes to sustainability, while fishery management that contributes to inequality in the distribution of wealth and power in society, contributes to the causes of unsustainability which may ultimately be expressed as fishery collapse due to a failure to protect the fishery environment.

2.1.2 FISHING RELATED IMPACTS

Fishing causes ecosystem impacts beyond the direct effect on target species. Non-target species are also caught and often discarded. This by-catch may include endangered species and comprise a significant amount of the total catch. Prawn trawling for example may have a by-catch component of up to 90 percent of the total catch and may include endangered species of sea turtles. These unwanted organisms are usually discarded but are often badly damaged and unlikely to survive.

Destructive fishing practice is also an issue that has been widely reported. The destruction of marine benthic habitats by trawling is a major concern. McCully (1991) demonstrates that these problems of resource waste and destruction are generally more

closely associated with capital intensive industrial fisheries. Mace (1997) points out that destructive fishing is not limited to capital intensive fisheries but includes the use of dynamite and cyanide poison which has decimated some coastal fisheries. If ecologically sustainable fisheries development requires that more ecologically efficient use be made of limited fisheries resources, then destructive fishing practices need to be replaced by practices that are more in sympathy with ecological processes.

2.1.3 OVERFISHING

Overfishing is a major contributor to the global fisheries crisis. Fishery managers have sometimes been criticised for overemphasising the role of fishing pressure and paying insufficient attention to other factors that affect fish stocks. Their focus is understandable given their limited management options. Overfishing is clearly the cause of many fisheries failures and is often the factor most easy to rationalise. Fishing effort and catch can be quantified and can often be seen to relate directly to impact on fish populations. It is also a factor that seems to be controllable through management of fishing activity. Of course recognising the need for restraint is not the same thing as actually achieving it, and attempting to regulate fishing effort is the perpetual preoccupation of fisheries management.

Defining overfishing is not as straightforward as it may seem. Obviously the term implies a level of fishing pressure that exceeds that which is desirable, but the threshold between what is acceptable and what is considered overfishing is not an absolute. It is value-dependent; a matter of perspective. In particular there is a distinction between biological overfishing and economic overfishing. Economic overfishing may be used to describe a fishery that is not producing the optimum level of economic rent because of overcapacity. Too many boats and fishermen competing for a share of the allowable catch can be economically inefficient in relation to a particular economic goal.

Biological overfishing may refer to a situation where excessive fishing pressure compromises the productivity of the fishery in biological terms, or threatens the survival of species. Aiken and Sinclair (1995) describe recruitment overfishing as referring to the situation where too many fish are harvested, leaving too few to breed and produce desirable numbers of fish in future generations. Growth overfishing refers to the situation where fish are harvested too early in their life cycle, before growing to the size that would maximise their productive potential.

A level of fishing effort appropriate to achieving maximum sustainable yield from a fishery would usually be considered overfishing according to rent maximising models (this will be discussed further in chapter 5). The levels of fishing pressure appropriate to achieving both of these management objectives might be interpreted as overfishing

from the environmental perspective of minimising disturbance to ecosystem function and avoiding risk and uncertainty according to the precautionary principle. If a fishery is viewed from a social and economic perspective, one may see overfishing in other terms. For example, market oversupply due to overfishing could lower prices and affect fishing communities by shifting rent from fishers to consumers.

2.2 CAUSES OF OVERFISHING

2.2.1 POPULATION AND TECHNOLOGY - AN ECOLOGICAL PERSPECTIVE

In many ecosystems there is some balance in the relationship between predators and prey. Species that have co-evolved over a long period of time have developed sustainable patterns of interaction and often have a high degree of interdependence. Unstable predator/prey interactions often occur where a naive prey population is exposed to predation from a new predator, a species recently introduced into the system with which it has not had the time or opportunity to evolve defenses (Flannery 1994: 142).

There are many examples of introduced predators causing extinction of native flora and fauna, and many examples of human colonisation of new territories causing mass extinctions of native species. In *The Future Eaters*, Flannery (1994: 136-187) suggests that the arrival of human predators caused the mass extinction of the mega-fauna of New Zealand and Australia. In the case of New Zealand this occurred in recent times, and there is a good record of the events that occurred and the social consequences (Flannery 1994: 242). Early arrivals found an abundant food supply in the native fauna, especially the Moa, a giant flightless bird (Flannery 1994: 243). These creatures were easy prey as they lacked any instinct to avoid humans or any means of defence against them. The human population increased unconstrained by ecological mechanisms until the last Moa had been consumed. Other food resources, including fisheries, were also depleted (Flannery 1994: 244). Overharvesting large fauna to the point of extinction left the Maori inhabitants with an impoverished ecosystem that could not sustain their population. Social collapse was the inevitable consequence, marked by the development of a culture characterised by cannibalism and perpetual intertribal warfare (Flannery 1994: 247-253).

Humans are a new predator in many fishery ecosystems. Like naive island fauna, many fish have not evolved defences against human predation. The aquatic world they inhabit is a foreign environment to which we are poorly adapted. It is only through technology that we have gained access to these environments and their resources. Development of the sophisticated technology required to fish offshore and at great depth is a very recent phenomenon. Certainly there has been no time for affected species to evolve defensive

adaptations. As a consequence, these species are vulnerable to overfishing and the risk of extinction.

Other fisheries, particularly in coastal and littoral environments, have been targeted by humans for many thousands of years. One might expect selective pressures over such a long period of time to have brought about some stability and resilience in these systems. In many cases this has occurred, but the equilibrium is threatened by recent technological developments, particularly in the use of fossil fuels.

Use of fossil fuels has had a major impact on the equilibrium point of the predator/prey relationship between fishermen and fish. The reasons for this relate to efficiency constraints and the difference between ecological, energy based systems and financially based ones. Energy budgets are the fundamental constraint shaping ecological systems. It is a universal rule of predator/prey interactions that more energy must be obtained by consuming prey than is expended in capturing it. If this were not the case the predator would become energy deficient and starve.

This law imposes discipline on predators and through ecological feedback mechanisms helps to maintain some sort of balance between predator and prey populations. From this simple model it follows that, should prey populations decline due to excessive levels of predation, perhaps because predator populations have grown too large, they become harder to find and catch. Once the scarcity of prey is such that it requires more energy to find and capture them than is gained by doing so, the predators begin to starve and decline in numbers until some balance is re-established. This constraint of ecological efficiency is observed in some fisheries where there is limited access to technology, such as Stoffle *et al.* (1994) observed in a study of a fishing community in Buen Hombre in the Dominican Republic.

Use of vessels powered by fossil fuels, and economic incentives provided by insatiable commodity markets, enables fishermen to evade these ecological constraints. They operate according to the constraints of financial budgets rather than energy based ones. While it may be economically viable to use 10 litres of fuel costing 50c per litre (total cost: \$5) to catch 1 kilogram of fish with a value of \$10. The energy diseconomy of this exchange would probably exceed a factor of a hundred.

This anomaly between financial and energy economies, and the power that use of fossil fuels gives to fishermen to evade ecological constraints on fishing effort, makes possible much more intensive fishing than would otherwise be viable and can threaten the biological sustainability of fisheries.

2.2.2 OPEN ACCESS - TRAGEDY OF THE COMMONS

The belief that free or open access to fisheries is the fundamental cause of all fishery management problems is almost universal among fishery managers (Rothschild 1983: 160). Waugh (1984: 4) discusses the economic rationale which suggests that open access leads inevitably to overfishing. McVay (1966) claimed that the freedom of the seas was bringing about the extinction of species after species of fish and whales, and Hardin (1968) explored the issue more generally in his essay "The Tragedy of the Commons".

Hardin identified the conflict between the interests of the individual and the interests of the wider community. He argued that a rational individual would pursue actions of benefit to that individual even though they imposed greater total costs on the wider community. If the individual's benefit from an action exceeded his or her *share* of the total cost imposed on the community, then he or she would, in the absence of other influences, pursue that action. The effect of a society of individuals each behaving in this way is ultimate ruin for all. It is an irrational and unsustainable course for a society to follow if viewed from a *holistic* perspective, but it is the inevitable result of allowing individuals to pursue rational *self* interest at the expense of the community in a commons.

It is important here to emphasise the distinction between what Hardin referred to as the commons, which was in effect property owned by nobody, and the concept of commons that refers to property that is held in common ownership, that is owned by a community or group and that may be managed according to rigorous controls.

The problems of open access in regard to fisheries are discussed by Waugh (1984 :4) in relation to specific fishery case studies. Waugh notes "the persistent trend toward depletion" that occurs, and suggests that open access always leads to overfishing as more and more resources of labour and capital are drawn into the fishery, resulting in the dissipation of resource rent. Hodge's (1995: 38) analysis of the economics of overfishing concurs with that of Waugh - open access generally leads to economic overfishing, however Hodge notes that this does not necessarily cause biological overfishing or lead to extinction. This is an important point. Extra effort is only exerted in the fishery to the point that the extra costs involved are exceeded by the value of the extra fish caught. As increased fishing effort depletes the stock it raises the marginal cost of capture. An equilibrium point is eventually reached, and economic models and experience demonstrate that this inevitably exceeds the desirable level of effort to maximise economic returns, i.e. economic overfishing. Whether economic overfishing or biological overfishing, and possible extinction, occurs first is dependent on many factors, including target species ecology, fishing costs and market value for the fish.

Generally reduced efficiency of capture technology reduces the risk of biological overfishing as economic factors curb fishing effort at lower levels. This explains the wide application of efficiency constraints to promote fishery conservation. The drawback of efficiency constraints is that they undermine the potential to generate rent from the fishery. (This issue is discussed further in chapter 5.)

The only answer to the problem of open access is some form of control to limit fishing effort. While this is generally accepted, there is room to debate the form and extent of restriction that would be most desirable. There are a number of options for limiting effort and all impose some restriction on the freedoms of individuals. Objections may be found for all of them, but as Hardin points out we have to choose or allow the commons to be ruined. Options for limiting effort usually entail an implicit allocation mechanism. Restraint could be achieved by limiting the amount that any individual could take. This might promote social leveling and community sharing of the resource. Alternatively restraint could be achieved by restricting which individuals have access to the resource. This would tend to promote inequality, because the privileged would gain exclusive access.

Traditional fishery management has experimented with many input controls to limit fishing effort. The effectiveness of controls is often undermined by the responses of fishermen to counter them and by concern that they introduce economic distortions and inefficiency into the conduct of the fisheries; that they fail to generate the maximum potential resource rent. Economic rationalists argue that the solution to problems of fishery management is privatisation. They argue that individuals should be granted exclusive ownership of a fishery in the form of exclusive, transferable property rights which would provide the incentive and ability to manage them properly. This in theory would internalise all the costs as well as the benefits of fishery practices. The economic waste and inability to promote sustainable practices in the open access regime would be overcome. In short they propose enclosure and privatisation as a solution to the tragedy of the commons. (This is discussed further in chapter 3.)

2.2.3 THE POLITICS OF RESOURCE USE

While much of the blame for overfishing is often attributed to the greed of fishermen, scientists and politicians are also criticised for failing to restrain them. Sharp (1995) argues that the underlying science that is the basis of "sustainable" fisheries decision-making has been responsible for a great portion of the deterioration of fishery resources. Government, after all, generally assumes responsibility for managing fisheries on behalf of the community. When fisheries fail, politicians often lay the blame on the inadequacies of their scientific advice. Fishery managers, on the other hand, are often frustrated in their attempts to conserve stocks because politicians are reluctant to

confront vested interests. In a detailed analysis of the decline and collapse of Canada's east coast ground fishery, Schrank (1995) highlights the lack of political will to make tough but necessary decisions as the chief factor leading to failure. Mace (1997) and Pearce (1996) note that a report on the fishery crisis to the British House of Commons (House of Lords 1996) criticised decision makers for lacking political will, and also castigated scientists for failing to give firm and bold advice. Ambiguity provides decision makers with an excuse for political compromise, and while the resources devoted to fishery research are inadequate, even if better information were available, political considerations would probably carry more weight with decision makers.

Unfortunately it is seldom possible or practical to obtain a sufficient scientific understanding of any fishery to eliminate uncertainty. There are generally vast areas of imprecision. The problem occurs when decision makers take an unduly optimistic approach to this uncertainty, rather than a suitably precautionary one. Leftwich's (1983) analysis of politics provides a framework for understanding why they invariably do so, a tendency which is fundamental to the problem of sustainability. Leftwich defines politics in terms of how a society uses and distributes resources. He asserts that:

Control over resources is the essence of power in any society (1983: 219);

and that:

To separate the question of the use, production and distribution of resources from the question of the use and distribution of power is to empty politics of its real content (1983: 21).

According to this analysis, since the global fishery crisis is a consequence of the way society uses fishery resources, it is a consequence of politics in terms of the distribution of power in society. But what are the elements of politics that contribute to unsustainable patterns of resource use?

In many societies, including all industrial societies, power and the ability to make decisions over how resources are used is concentrated in the hands of small groups who control resources through private ownership or through control over the public sector. The private sector is not in any way democratically accountable to the community, and as Leftwich (1983: 220) demonstrates, the public sector is "far less subject to wide, regular or effectively popular or democratic control than is sometimes claimed in the official ideology of parliamentary democracy".

Decision-making procedures within the institutions of government that control the use and distribution of public resources are, as in the private sector, characterised by hierarchy, restraints on wide and popular participation, and secrecy (Leftwich 1983: 224). Individuals compete for top decision-making positions, and the benefits that go

with them, within the hierarchies of both private and public sectors. Appointments to these positions tend not to be made by open or democratic processes but are carefully selected from an “establishment” of trusted elites. Politicians and agency scientists are part of the structured hierarchies of social power. They rarely make decisions that go against the interests of the power structures of which they are a part, because this would also be against their own interests and against the values and political orientation to which they will have become conditioned during the development of their careers.

This explains why decision-makers avoid confronting vested interests. There is no need to posit conspiracy. As long as decision-makers are steeped in the ideology of market capitalism and believe that pursuit of economic efficiency, and the generation of employment through investment, development and growth are the necessary steps to improved civic life, they can act in good conscience. But Saul (1997: 155) points out that they are deluding themselves. They cannot see the larger picture of the public good beyond the limits of their own defined interests.

Control of resources by a relatively small minority with little accountability to the wider community results in patterns of resource use that favour the vested interests of those with power, rather than the best interests of the wider community or society as a whole. This provides circumstances for a tragedy of the commons to occur. The prime interest of the power elites is to maintain the *status quo*. To maintain control they need to use their decision-making power to ensure that resources are used in ways that perpetuate the conditions of inequality in society. Maintaining their relative advantage in power and wealth is the critical concern, irrespective of whether outcomes improve or detract from the overall well-being of society. In capitalist societies, inequality is maintained by managing resources in ways that maintain the value of capital assets and favour the concentration and distribution of economic benefits to capital, of which elites own a disproportionate share, rather than dispersing it among the wider population.

Fisheries that may nominally belong to the community are exploited by vested interests at the expense of the community and are in fact treated as if they were the private property of elites, being enclosed by restrictive licensing laws limiting access to the resource, or by mechanisms of capital efficiency by which capital is the means of enclosure. The interests of elites may be furthered by emphasising returns to capital and resource mining, whereas the interests of the community might be favoured by returns to labour, the generation of employment, and resource sustainability.

This view of the politics of resource use gives a different perspective to the fishery crisis. Perhaps it is not due to the failure of fishery management, but to a failure of the political forces that direct that management to reflect the values of sustainability and the

wider interests of the community. The values that are emphasised in actual management are not the same as those that are expressed for public consumption. The rhetoric may emphasize sustainability but the practice may emphasize the service of capital and these two may be incompatible. The fishery crisis may not be a crisis at all from the perspective of elites. Their prime objective is to use fisheries in ways that sustain or increase their positions of relative advantage and power in society. If they profit from unsustainable practices then this objective is furthered. Furthermore, the decline of fisheries on a global scale may create a situation of economic scarcity that can paradoxically increase the value of enclosed fisheries. This can obviously be to the benefit of those who control them. The crisis also can be used to justify privatisation and other means of enclosure of fishery resources which enable elites to further consolidate control over them.

Democratic participation and public scrutiny and accountability are resisted and decision-making is shrouded in secrecy and obscured by the processes of bureaucratic government. Meaningful democratic involvement is practically non-existent. This view is supported by Saul's (1997: 77-116) analysis of modern society and the trend toward increasing corporatism. The concept of democracy is maintained, according to Leftwich (1983: 234) as a myth and an ideology that helps to distract the public from concerns over the real administration of power in society.

Leftwich demonstrates that democracy is incompatible with the competitive and inequalitarian nature of market capitalism while other writers including Drummond and Symes (1996) demonstrate the incompatibility of capitalism with ecological sustainability. It seems likely that achieving ecologically sustainable fisheries, and societies in general, is dependent on containing the socially and environmentally destructive expansionist tendencies of capitalism. Eventually environmental constraints curb capitalism. It is the understanding that the well-being of society would be furthered if capitalist expansion could be limited by social measures, thereby avoiding the unpleasant implications of environmental constraints, that motivates desires for ecological sustainability. Participatory democratic decision-making offers the best hope of achieving this, and participatory democratic decision making is dependent on the equalisation of wealth and power.

3. CORPORATE RESPONSE TO THE FISHERY CRISIS

3.1 INTRODUCTION

The growth imperatives of capitalism embodied in corporate entities can be met in two ways; by outward expansion and growth accompanied by increasing exploitation of the environment until constrained by ecological limits, or by inward expansion and increasing exploitation of people until constrained by social limits. In fisheries, the expression of these expansionist growth imperatives drives the development of intensive industrialised aquaculture and the enclosure of fishery resources. Science is used to support these developments that serve to protect capitalist interests and maintain the *status quo* (Symes 1996: 11).

3.2 ENCLOSURE

Territorial exclusion is one way to limit access to fisheries. Many traditional fishing communities practice it, and the concept has been extended by nation states which, since ratification of the Third Law of the Sea in 1976, have claimed jurisdiction over the waters up to 200 nautical miles from their coastline.

This had tremendous implications for global fisheries as the "freedom of the seas" became a thing of the past and most of the world's productive fishing grounds were enclosed by nation states. The 200 mile limit did not, however, solve the problem of overfishing. Schrank (1995) suggests that it contributed to the problem by stimulating growth in capacity, and Rothschild (1983: 153) points out that the optimistic projections that extended jurisdiction would increase the absolute wealth generated from fisheries and provide for more equitable and efficient distribution of that wealth were not realized. Many fish migrate around the oceans and thus do not remain anyone's exclusive property within a single national jurisdiction. There may still be an incentive for a state to encourage its fishermen to catch as much as they can before fish swim across the border into someone else's territory; and there still remains the problem of the commons. The fish in territorial waters became the common property of a country's citizens. Protecting their interests by sustainably managing the fisheries became the responsibility of government. Yet many governments have failed to protect their fisheries. They have lacked either the will or the ability to restrain fishermen. They have been unwilling to confront the power of capital by imposing economic restraints, or to confront the power of the electorate by imposing social restraints on fisheries exploitation. Sustainability has therefore been compromised.

They have often failed in this responsibility because the requirements for sustainable management are often at odds with the interests of the fishing industry to achieve short

term economic gain, and of politicians susceptible to lobbying by industry, and with their own short term interest in generating maximum economic throughput. Fishery science is fraught with inaccuracy and imprecision and this, along with the inherent difficulties of enforcing compliance with rules and regulations on fishermen, has given politicians and management agencies a useful excuse for their failures.

3.2.1 PRIVATE PROPERTY RIGHTS TO FISHERY RESOURCES

Economists argue that property rights will resolve the conflict between the objectives of sustainability and short term profit. Cotgrove (1997) defined the economics perspective of sustainable resource management in the following way:

Unrestricted open access will ensure the decline of a species until the cost of catching the diminishing resource exceeds the revenue to be gained from selling it;

and that:

Conservation can only work if there are clear and enforced ownership rules, either private or communal, to protect future values ("scarcity rents") of the resource;

and that conservation depended on the establishment of:

Well defined and protected property rights.

The qualifications of these principles are often overlooked. If access is **restricted** by natural or management imposed efficiency constraints, as discussed in chapter 5, then there is **no need for property rights** to promote conservation. And where property rights are required, communal property rights are an option to private property rights. These qualifications are essential to the validity of these *economic principles of sustainable resource management*, but they are often ignored by those seeking to establish or maintain privileged access to resources by perpetuating **the myth that "private property rights are essential to resource conservation"**.

The economic rationale suggests that issues of sustainability verses short term profits would be internalised and there would no longer be the need to impose restrictions on fishermen, if they instead of the public owned the fish. Kesteven (1997: 81) argues that:

Fishers must be given rights in their fishery and accordingly must accept responsibility for it. The incentive must be double: positive in the direct benefit of the opportunity to participate and the security provided by the property right: and negative in the threat of loss of that opportunity if responsibility is neglected.

Competition between fishermen that leads to economic overfishing could be countered by giving each fisherman a fixed share of the fishery, allowing each to catch a specified share of the total catch, the level of which would be agreed each year with the help of fishery scientists. Economic efficiency would be encouraged by making the shares tradable (Clark 1993). The public property of the fishery would thus be converted to private property, in other words enclosed.

As discussed in chapter 5, private property rights may not be required to serve conservation objectives, but they are essential to the political-economic objective of producing an economic surplus from the resource (Clark 1993). These arguments for particular economic outcomes are not value or perspective free, nor independent of political bias. They serve the interests of capital, and thereby advance the interests of one group in society, the capital rich, over those of the capital poor.

Brubaker (1996) advocates the establishment of private property rights as the key to fisheries conservation, because only private property rights receive legal protection. A number of case studies are used to illustrate the argument in respect to fisheries damaged by pollution produced as a result of industrial developments or sewage discharges. Under common law in both Canada and the Britain, individuals may only bring legal actions against polluting activities that affect their private property rights, and not against activities that affect fisheries to which the wider public have common rights of access. These actions can only be brought by the Crown and, as Brubaker points out, the Crown is not generally inclined to take action against activities for which it is responsible or in which it may be a participant.

The institutionalised bias in the legal system contributes to the maintenance of the status quo by protecting the interests of a capital rich elite, who disproportionately own most of the private property, against the interests of the general public, who may have access to no other resources than those that are accessible to all. Brubaker has illustrated the failure of legal institutions to protect the common-good against the depredations of profit seeking private interests. Accepting this state of affairs, it may be logical to argue that the way to achieve resource conservation is to give ownership and therefore the incentive to preserve resources to those with the power to do so.

This logic may appear effective in the short term, but it does not address the underlying problem. The failure of the law to protect the public interest against the private interests of those with power is a consequence of the consolidation of power in too few hands. It is the consequence of inequality, and the privatisation of additional public resources will not remedy this fundamental problem, but exacerbate it.

Brubaker (1996: 227) notes the ineffectiveness of government bureaucracy in promoting resource conservation and environmental protection and points out that bureaucrats are seldom sanctioned for irresponsible decisions. On the contrary, they often enjoy professional rewards while presiding over declining water quality and threatened fish habitats. But she also notes that governments are more likely to act to protect fisheries if there is a political need to do so. "If the effects of permitting pollution are concentrated on a limited number of fishers, the political costs are low". This could support an argument for maintaining widespread rights of access. It would also support an argument to strengthen the effectiveness of democratic processes by promoting greater political equality. Even in imperfectly functioning democracies there is a political price to be paid for allowing polluting activities to compromise public resource values. No government can fool all of the people all of the time. And when widespread rights of access through public ownership exist, it becomes difficult to arrange compensation to buy off opposition to polluting developments. With private ownership on the other hand, there may be a manageable number of 'stakeholders', and it may be easier to compromise ecological values that do not have clear commercial value by paying nominal compensation to allow polluting developments to occur.

3.2.2 THE TRAGEDY OF ENCLOSURE

Tragedies of the commons often turn out to be tragedies of enclosure and it is often enclosers rather than commoners who bring about environmental destruction (Anon. 1992: 128). Enclosure of fisheries has a number of implications for society. The granting of exclusive rights means denial of those rights to all others. Enclosure entails dispossession and exclusion. Enclosure of fisheries as a means to achieve increased efficiency and raise rents is often accompanied by the need to rationalise the industry by persuading some fishermen to leave the fishery. Sometimes this is achieved by force and sometimes fishermen are compensated for their cooperation. However the effects of enclosure are not limited to those with a history of engagement in the industry. They extend to the wider community and to future generations as a result of lost opportunities, and these people are not usually compensated, although opportunity cost is generally recognised by economists. A person may live in a fishing community and never fish for a living, but gain a great sense of security from the belief that he has access to the resource and could resort to fishing should other economic options fail. The availability of alternative economic options, and particularly access to natural resources such as land or fisheries, provides people with a means to resist exploitation. Loss of such options weakens their power to bargain over wages and conditions of employment. Enclosure of land, forests and fisheries has often been used to force people from self sufficiency to dependence on employment for a living and to create circumstances that do not favour their position to bargain over wages and conditions.

Enclosure perpetuates the trend towards greater inequality of wealth in two ways. The powerful appropriate valuable resources and in so doing they directly enrich themselves. Dispossession further impoverishes the weak, reducing their options and bargaining power and the return they can get in exchange for their labour. The cheapening of labour benefits those in a position to exploit it. If the global trend toward increasing inequality of wealth is a serious social problem then enclosure is not likely to contribute to a solution. It is also unlikely to result in better protection for the environment. In a society of rich and poor, the poor are often too desperate to protect the environment and the rich have no incentive to do so if they can profit from its degradation and use their wealth to escape the adverse consequences. There are often direct financial benefits to be gained from using resources in unsustainable ways. Economic advantage may be gained by the owner of a fishery from mining it to extinction and reinvesting the profits elsewhere. Given the uncertainty over biological, market, political and economic components of most fisheries, it is likely that short term reward will often be favoured at the expense of sustainability and long term returns. In situations such as these the privatisation of fisheries does not solve the problem of overfishing. For these reasons, as well as for reasons of social ethics, it is necessary to "manage" fisheries. As Mackenzie (1993: 343) notes:

The alternative to letting the strong take what they want regardless of those less strong, regardless of need, regardless of alternative opportunity for those displaced, regardless of traditions and ways of life, is to manage the resource base.

In some ways the option of privatisation is an abdication of this management responsibility. Palsson and Helgason (1996: 58) note that growing inequality has been observed in fisheries where management based on an individual transferable quota system has been implemented and Pinkerton (1989: 18) notes the tendency under limited entry management systems for the emergence of an elite group who speculate in licences and cause their value to become capitalised beyond the means of ordinary fishermen.

3.3 AQUACULTURE

While privatisation is widely promoted as the solution to the problem of overfishing, aquaculture is promoted as the solution to meeting the world's growing demand for seafood products. In 1992 global aquaculture industries produced about 12 million tonnes of product compared to the 60 million tonnes of product suitable for direct human consumption that is harvested from the capture fisheries (Aiken and Sinclair 1995). Acknowledgment that capture fisheries are being exploited to their limits, leaves growth in aquaculture as the obvious direction to look for solutions to maintaining growth in fisheries production to meet the growing demand for fish products. But if

aquaculture is to provide long term solutions, the question of sustainability must be addressed. Gowen (1991: 24) notes that consideration must be given to the broader implications of the social, economic and environmental impacts of aquaculture development which is more often motivated by profit than food production, whilst Cross (1991) notes that many aquaculture developments promoted by agencies such as the FAO have been inappropriate and have served the interests of bureaucrats and politicians rather than the rural poor that they are intended to help.

Aquaculture has a very long history. Fish have been kept and grown in freshwater ponds for thousands of years and socially and environmentally sustainable methods of production have evolved. Sustainable, small-scale methods of fish culture are widely practiced (Cross 1991; O'Riordan 1996). Asia leads in the production of freshwater fish, primarily to meet local subsistence needs, and annual production is estimated at 8 million tonnes (Csavas 1994). This is a significant proportion of global fisheries production.

Aquaculture can contribute to improvements in the productivity of wild capture fisheries. Juvenile fish may be released into the environment, supplementing natural recruitment. This is often a means of enhancing fisheries limited by inadequate recruitment as a consequence of loss or degradation of spawning and juvenile nursery areas. It has been widely used for over a century to enhance fisheries for salmonids and other diadromous species where up-river spawning migrations have been interfered with by hydro-electric dams or other barriers.

In contrast to the relatively benign practices of traditional, subsistence aquaculture, recent developments have focused on the rapid growth of industrial marine farming of high value seafood products for global markets. Aikens and Sinclair (1995: 26) note that there are significant social and environmental impacts associated with these developments:

Export aquaculture has a different relationship to the local ecology and the social fabric of coastal communities; it has often been associated with unrestrained development in the coastal zone, exploitation of natural resources and negative social and environmental impacts. Thus the public often perceives marine aquaculture to be an aggressive competitor for limited coastal resources, one that is driven by powerful economic and political forces and which is capable of doing serious damage to our coastal environments and our traditional fisheries.

A number of species are produced by intensive industrial methods but salmon and marine shrimp production represent the largest export oriented industries. These

industries demonstrate most of the issues and concerns associated with industrial aquaculture in coastal zones (Aiken and Sinclair 1995).

3.3.1 ECOLOGICAL IMPACTS OF AQUACULTURE

Shrimp farming has been associated with severe environmental degradation. Destruction of mangrove wetlands has been widespread. Holmes (1996) reported that 17 percent of Thailand's mangroves were destroyed between 1987 and 1993. Land subsidence and salination of freshwater aquifers has also occurred (Holmes 1996; Aiken and Sinclair 1995). Mangrove wetlands are key habitats in tropical marine systems. They are the nursery areas for many coastal marine fisheries and their loss can significantly impact on the health and productivity of marine ecosystems extending far beyond the immediately affected locality. Some researchers suggest that total productivity of mangroves is reduced by farming over them (Macintosh and Phillips, cited in Aiken and Sinclair 1995). Patel (1996) reported that a Supreme Court in India ordered the closure of industrial-scale shrimp farms because of the severe environmental damage they caused.

Salmon farming also has severe environmental impacts. Organic wastes from faeces and uneaten food accumulate on the sea floor under the cages (Gowen 1991: 25-29). Sediments can become anoxic and produce and release methane and hydrogen sulfide into the environment. Dissolved nutrients are added to the water column in large quantities and can stimulate algae growth including blooms of toxic dinoflagellates. These impacts can extend far beyond the source of pollution and affect the viability of the farming industries that produce them as well as affecting the wider ecosystem. Folke, Kautsky and Troell's analysis (1994) of the effects of eutrophication from salmon farming leads them to conclude that industrial salmon farming as currently practiced is not only ecologically unsustainable but economically unsustainable as well. Society, they argue, bears the huge cost of subsidising industry to the extent of the environmental damage it causes.

Other concerns associated with intensive aquaculture include the use of antibiotics and other chemicals to control diseases (Gowen 1991: 31), and the impact farming can have on wild fish populations (Gowen 1991: 29). Culture operations may increase the incidence of disease in wild populations as a result of the transfer of pathogens in stock or feeds, and farmed stock may escape and interbreed with local populations, impacting on the genetic integrity of wild stocks.

Ecological efficiency is another issue, particularly for fish culture that relies on fish based feeds. It requires the use of between 5 and 10 tonnes of fish to produce the fishmeal to manufacture the feed required to grow 1 tonne of salmon or shrimp by

intensive aquaculture (O'Riordan 1996). Many of the fish species harvested for use in animal feeds can be used for direct human consumption if appropriate capture and processing methods are employed. Marine farming of species dependent on fishmeal diets does not therefore contribute to the global supply of seafood. On the contrary, ecologically speaking, it is a reduction process because it converts more fish into less. Holmes (1996) asserts that one of the enduring myths of aquaculture - that it will reduce the burden on wild harvest fisheries - is false. Industrial fish farming is also heavily dependent on energy and the use of fossil fuels which also have associated environmental impacts.

Production of filter feeding molluscs such as mussels and oysters can also be detrimental to marine and estuary ecosystems and affect wild fisheries. Fishing down the food chain, targeting lower trophic levels in fishery ecosystems, is of concern in relation to harvest fisheries. Phytoplankton are the lowest trophic level in most aquatic food chains. They are harvested from the water in oyster and mussel farming operations which are in effect, fishing operations using dense concentrations of filter feeding shellfish as a biological fishing gear. Shellfish farms are usually sited in areas of high productivity, such as estuaries, where nutrient inputs sustain high phytoplankton concentrations which support good growth rates. These areas are also important nurseries for many other species of fish precisely because of the high concentrations of phytoplankton upon which the survival of the fry of many fish depends in the critical phase of development following absorption of the eggsac. If phytoplankton concentrations are reduced below threshold levels, the fry will not survive, and it is conceivable that shellfish farms in estuaries could significantly reduce survival of fry of particular species in particular situations.

3.3.2 SOCIAL AND POLITICAL IMPLICATIONS OF AQUACULTURE

There are social and political implications of industrial fish farming that impact on coastal communities and have a bearing on the wider issues associated with sustaining fishing communities and the ecological components of fisheries. Aiken and Sinclair (1995: 31) note that:

The sociological impact of modern aquaculture on coastal communities has, by and large, been a disappointment to politicians and others who hoped aquaculture would improve the standard of living in coastal communities and provide alternative employment for fishers and their families displaced from the traditional harvest fisheries.

The individuals who invest heavily in the development of the industry are usually entrepreneurs, not farmers. They tend to be from outside the coastal communities in which the development occurs and their objective is to make

a return on their investment, not solve local social problems. In many of the less developed countries, small fishers have lost their rich local fishing grounds and coastal landowners have lost their rural subsistence, often ending up in the slums of urban centers.

Establishment of marine farming industries in coastal areas has often come into conflict with established interests. Visual amenity, environmental quality and property values are affected, and fishing and navigation may be restricted (Gowen 1991: 39). These conflicts of interest are usually decided at the political level where the concentrated, capital rich marine farming interests often have sufficient influence to prevail over opponents who are often dispersed, divided and disorganised. There is the potential for politically influential marine farming interests to 'capture' government agencies responsible for regulating them. Agency capture results in an agency favouring the interests of a client group over the interests of the wider community. With regard to marine farming it may see a regulating agency devote its resources to protecting industry from the environmental and social concerns of the public instead of protecting the public interest from environmental abuses by industry. The dangers of agency capture and the conflict of interest between marine farming and coastal environment issues provide a strong argument to separate the government functions of regulation of the aquaculture industry, and protection of wild fisheries and the marine environment.

There can be competition between culture and capture fisheries for markets. This can be detrimental to traditional coastal fishing communities. An article in *The Economist* (Anon. 1996a) described the plight of Alaskan salmon fishermen who were being forced into bankruptcy because of a depressed market brought about by the global oversupply of farmed salmon. This was occurring despite abundant catches and healthy stocks of wild fish.

It is difficult for traditional fisheries to compete in many markets against cultured products. Industrial methods can provide regular, predictable supplies of a reliable quality to match market demands, while capture fisheries are less predictable and supply may be affected by the vagaries of weather and other factors. This makes farmed product more attractive to the mass marketing and distribution methods of the global trade in fish products. Even environmentally concerned consumers may believe that farmed salmon represents a better environmental choice.

These factors may undermine public, political and economic concerns for the conservation of wild fisheries and the environments and ecosystems that sustain them. If farmed salmon can replace the wild fishery in the market, it may no longer seem so important to protect the rivers and streams upon which wild salmon depend, and the commercial interests of those who 'own' the production processes of farmed salmon

would be served if potential competition from the wild fishery was permanently precluded.

4. CASE STUDIES OF SUSTAINABLE FISHERIES

4.1 INTRODUCTION

This chapter contains brief descriptions of three fisheries which have demonstrated ecologically sustainable characteristics. In each case this success has been in notable contrast to the failure of comparable fisheries within each region. The three fisheries appear to have little in common. They include a small Caribbean village and surrounding reef and mangrove system, an oyster fishery in an estuary in southern England, and the coastal fisheries of Norway. Despite the differences, there are common characteristics of management that have contributed to sustaining ecological health and productivity. The success of these characteristics across a broad range of fisheries and in contrast to the failure of comparable fisheries that lack them, suggests that they may play an important role in achieving ecological sustainability.

4.2 BUEN HOMBRE

The first case study is of Buen Hombre, an isolated village on the north coast of the Dominican Republic which was the subject of a study by Stoffle *et al.* (1994). The village has a population of 800 which includes 45 adult fishermen. Villagers engage in multiple occupations including fishing and farming, and produce a diversity of commodities including a wide variety of seafoods and crops for personal use and for sale. Advantages of this pattern of *economic and occupational pluralism*, a term which Stoffle *et al.* (1994: 118) attribute to McGoodwin (1990: 116-118), include a reduced risk of total economic failure, and a reduced risk of the environmental degradation that could be caused by more intensive exploitation of particular environmental resources that would necessarily accompany a greater economic dependence on the production of fewer commodities.

The Buen Hombre fishery is based on a reef and mangrove ecosystem that Stoffle *et al.* (1994: 115) describe as "one of the most vital and biologically diverse in the Caribbean, even though it has been intensively fished for 100 years by local villagers". This is in stark contrast to the neighbouring reefs to the east which have been degraded as a result of overfishing and tourism, and those across the border to the west in Haiti which are described as biologically dead.

4.2.1 FISHING PRACTICES

The principal method employed by the Buen Hombre fishers is spear fishing while free diving. Crab pots and traps are also used. The use of nets referred to as *chinchoro* nets is prohibited, as is the use of underwater breathing apparatus using compressed air (Stoffle *et al.* 1994: 126).

Fishers harvest a diversity of species including parrot fish, grouper, snapper, crab, lobster, conch, shark and barracuda (Stoffle *et al.* 1994: 117). By deliberately targeting multiple species they reduce the risk of overfishing any particular species and this helps to maintain ecological balance and stability. The total sustainable yield from a fishery is also greater if many species are exploited rather than just a few. If fishers notice that a particular species is becoming scarce they observe informal agreements to avoid targeting that species, and this allows populations to recover (Stoffle *et al.* 1994: 132).

The fishers of Buen Hombre are part of a close-knit community. They co-operate and usually fish in teams, sharing the costs of boat rental and fuel, and dividing the catch. This promotes equality and reduces the risk of jealousy and conflict that could undermine group unity if some fishers were able to become wealthier than others from the resource. They have formed an association which promotes unity and mutual support and fosters the development of a sense of community responsibility and obligation (Stoffle *et al.* 1994: 119). This is an important contribution to the development of a conservation ethic and the sense of social responsibility that provides a values basis for an ethical or moral imperative to support observation and enforcement of the rules that preserve the marine resources for the benefit of all.

4.2.2 THREATS TO THE BUEN HOMBRE FISHERY

There are a number of potential threats to the ecology of the Buen Hombre fishery. They include habitat loss as a consequence of tourism development, deforestation of the mountains inland from the coast, and overfishing by local fishers or by the ecologically destructive fishing practices of outsiders (Stoffle *et al.* 1994: 116). Removal or destruction of mangroves and coral would directly reduce fishery habitat, while increasing nutrient runoff from tourist resorts, or as a consequence of unsuitable land use practices, could affect the nutrient dynamics of the system resulting in dieback of coral reefs and reducing the productivity of the system as a whole.

The isolation of Buen Hombre has contributed to protection of the system in the past, but tourism is an increasing threat as holiday-makers seek more remote wilderness locations. If habitat degradation is to be prevented, the fishers may have to counter conflicting development interests. They are more likely to be able to resist adverse developments if they have unity and cohesion and enjoy a sympathy of interest and the support of the wider Buen Hombre community. Fishing is a respected occupation in the village and has a high level of participation; 45 adult fishers from a total population of about 800 persons (Stoffle *et al.* 1994: 116), an opportunity provided in part as a consequence of the technological inefficiency of the fishery. While fewer fishers using compressors could catch as much as the Buen Hombre fishers do by free diving, there

would be less people with a direct involvement in the fishery. Another consequence of "inefficiency" is its tendency to promote social leveling which reduces tensions that could undermine the unity and "common interest" that occurs as a consequence of the benefits and wealth of the fishery being widely dispersed among the fishers and throughout the community.

4.2.2.1 Overfishing

The fishers of Buen Hombre are well aware of the dangers of overfishing and they have developed a number of strategies to guard against it. Social strategies have been developed to reduce the resident population during times of drought and scarcity to avoid stress to the carrying capacity of the system (Stoffle *et al.* 1994: 116). There is a strong conservation ethic and fishers do not cut coral or mangrove and they avoid capturing smaller fish to allow them to grow to maturity (Stoffle *et al.* 1994: 120-121).

Possibly the most important single factor contributing to the avoidance of overfishing by the Buen Hombre fishers is their use of technologically "inefficient" fishing gear. This allows natural feedback mechanisms to function that have the effect of limiting fishing effort to sustainable levels. Limiting technology makes the marginal cost of fishing more costly in terms of energy expended, that is in terms of the ecological cost of fishing to the fisherman. There is little potential to profit from the fishery. Thus fishing is a fairly marginal activity and hence it is sensitive to changes in fish populations that effect catch rates. If a particular reef area is overfished - causing fish to become scarcer and harder to catch - it soon becomes uneconomic to fish there any longer and the fishers concentrate their attentions elsewhere, or even cease fishing altogether and shift their efforts to other activities such as farming (Stoffle *et al.* 1994: 123). This allows the reef system's fish stocks to recover. The many species available to fishermen and their ability to be selective with the equipment they employ also provides a balancing mechanism. If the population of any species is reduced by overfishing or other causes - fishers consciously avoid targeting that species to allow the population to recover - thus helping to maintain a balance of species diversity. The inefficiency of fishing also provides protection to small fish. Stoffle *et al.* (1994: 121) explain that fishers have to target larger fish because they "provide higher returns in terms of the amount of protein-rich food compared to the amount of energy expended to catch them".

There are social gains from efficiency restraint in addition to the ecological benefits. Restriction on the use of technology provides greater opportunity and demand for the use of manpower in the fishery. It therefore provides more opportunities for employment and for increased participation and resource sharing by members of the community. Efficiency constraints also limit the potential for the fishery to produce an economic surplus that might stimulate competition and rivalry and thus threaten social

cohesion among fishers and between them and the rest of the community. Unity and cohesion among Buen Hombre fishers has contributed to their ability to resist encroachment on their fishery by outsiders.

4.2.2.2 Destructive Fishing by Outsiders

Encroachment by outsiders, especially commercial fishers from the nearby urban settlement of Monte Cristi, is a threat to the Buen Hombre fishery. The Buen Hombre fishers tolerate outsiders fishing in what they see as their territorial waters, as long as they fish by the same non-destructive methods employed by the fishermen of Buen Hombre (Stoffle *et al.* 1994: 129). It is the use of illegal technology such as *chinchorro* nets and compressors to which they object (Stoffle *et al.* 1994: 129). Use of compressors and underwater breathing apparatus greatly increases a diver's effectiveness and fishing power and in the Buen Hombre fishery this could lead to overfishing. Use of *chinchorro* nets causes indiscriminate overfishing of both juvenile and adult fish and may cause damage to benthic habitat such as sea grasses (Stoffle *et al.* 1994: 133).

In 1989 the fishers of Buen Hombre faced a crisis. They were finding it difficult to prevent encroachment by fishers from Monte Cristi using *chinchorro* nets. Appeals to officials in Monte Cristi had no effect in curbing encroachment and use of illegal methods. It is likely that these officials were politically unable or unwilling to act against the interests of the Monte Cristi commercial fishers. In response they suggested that overfishing by Buen Hombre fishers was the cause of the problem, and that the Buen Hombre fishers needed to be educated in conservation (Stoffle *et al.* 1994: 132).

It seems likely that the situation was only saved as a result of the involvement of an interdisciplinary team of American scientists who gathered evidence using sophisticated satellite monitoring equipment and underwater photography. Their evidence, the involvement of the Dominican Director of a natural resource conservation foundation, and widespread publicity of the situation in the media, convinced national-level government officials to assist the Buen Hombre community to enforce the existing laws against *chinchorro* nets (Stoffle *et al.* 1994: 133).

Official recognition of the rights of the Buen Hombre fishers may have given them the confidence to confront *chinchorro* fishers from Monte Cristi. In March 1991, after a standoff between the two groups, the fishers from Buen Hombre persuaded a group of Monte Cristi *chinchorro* fishers to remove their nets from the water and leave the area. Subsequently the Dominican government granted formal legal authority to the Buen Hombre fishers to enforce sanctions against illegal fishing and arrest violators (Stoffle *et al.* 1994: 135).

4.3 THE FALMOUTH OYSTER FISHERY

The estuary of the River Fal in Cornwall on the south west coast of England is home to a unique fishery. The Truro oyster fishery is the sole survivor of many inshore and deep-water natural oyster fisheries that thrived around the British coast in the early years of the twentieth century (Davies 1995: 173). Overfishing made a significant contribution to the destruction of most of these fisheries. This occurred as a consequence of the shift from sail to motor propulsion in fishing vessels. The increased efficiency of motor powered fishing boats made it profitable to persist in fishing until oyster populations had been depleted to very low levels from which they could not recover and could no longer maintain viable populations.

Many of the oyster fisheries were "free-fisheries", unmanaged and unregulated, and there were no provisions to counter the increased fishing power of modern vessels. Davies (1995: 6) explains that the Truro fishery escaped extinction from overfishing by virtue of bylaws made in 1868: "Forbidding the removal of oysters from the Truro Oyster Fishery by means of mechanically propelled craft". As a result of this bylaw, vessels engaged in the Truro fishery were restricted to the use of sail. This greatly limited their fishing efficiency and conservation of oyster stocks occurred because it was not profitable to overfish. Today the Truro fishery is home to the world's last fleet of oyster dredgers still working under sail alone, and Davies (1995: 6) suggests it is no coincidence that it is also the single surviving natural or wild oyster fishery on the British coast.

4.3.1 FISHING PRACTICES

Conservation is achieved by limiting the efficiency of technology employed in the fishery. The vessels operating in the fishery are typically 22 to 30 feet in length, of heavy displacement, and with a long keel (Davies 1995: 8). The gaff-rig is favoured because it is suited to the sail-management requirements of dredging. Motors are fitted to some boats but are not allowed to be used while fishing. The crew is generally from one to three persons and the oyster dredges used measure about a metre across.

A number of regulations apply to the fishery in addition to the no motor rule. There is a size limit with a ring 2 5/8 inches in diameter used as a measure. A bailiff employed by the local government authority ensures compliance by going on board to check the catch at the end of each day (Davies 1995: 11). Fishing is limited to the hours 9am - 3pm on weekdays and 9am - 1pm Saturdays (Davies 1995: 10). However it is the no motor rule that is the key to conservation of the fishery because it limits fishers to the use of very inefficient sailing vessels. In Davies (1995: 173-175) words:

A sailing smack is a very inefficient tool for catching oyster for a variety of reasons. Firstly the dredges themselves... pick up only 15 out of every 100 oysters. Secondly...if there is no wind they cannot work... Thirdly, oysters are not evenly spread over the sea bed, but lie in patches. As a sailboat has to drift it can only pass over a patch once and then has to sail back upwind of it for another drift before it can catch from the same patch... A motor boat once having found the patch can go round and round on it fishing it until it's gone.

Davies points out that as the beds are thinned out and fishing becomes less rewarding, boats drop out as fishers turn to other more lucrative employment. But there is still a large stock of oysters left on the beds when it is no longer profitable to fish them, and this provides a breeding stock for replenishment. If motor vessels were permitted they would likely deplete the beds beyond the point from which they could recover. Davies (1995: 174) suggests that: "Once the stock drops below a certain level, the oyster seems to lose the will to propagate and then no spatfall can be big enough to save the fishery".

It may be that limiting the disturbance of the benthic sediments by preventing large, heavy, fast dredging maintains an environment that is suitable for spat settlement. The restricted efficiency of vessels ensures that fishing is a marginal activity. When oyster numbers are high the catches make fishing worthwhile, but when they are low and in need of protection, catches fall. When catches are no longer a fair compensation for the trouble of fishing, boats drop out of the fishery before biological overfishing occurs. The size of the active fleet fluctuates according to the health of the stocks and has varied between 50 sailboats in 1925 and 7 in 1935 (Davies 1995: 175). In the 1994-5 season there were 10 boats working (Davies 1995: 1). Fleet flexibility - the ability to respond to fluctuations in the productivity of the fishery - allows an ecological feedback system to operate which contributes to a sustainable fishery. This flexibility is enhanced by a situation of low sunk costs and high marginal costs associated with fishing. This relates to a low level of capitalisation as capital costs are often fixed whether the boat fishes or not, while labour costs are more closely tied to fishing activity.

It is important to note that this is not a recreational fishery. The work is hard and the weather often makes for unpleasant conditions. The fishers do it for money and while they may gain other values from a sense of tradition and pride in the skill in their work, it is essentially a job (Davies 1995: 210). The Truro fishery is not profitable in the sense of being an attractive opportunity for investment; indeed even the local authority cannot extract rent due to a bylaw providing that all profits be put back into the fishery (Davies 1995: 175). It is nevertheless a means to a living for fishers and a source of indirect economic benefits to the local community who would fight any move to change the "no motor rule" that keeps the fishery "inefficient and prosperous" (Davies 1995: 230).

4.3.2 THREATS TO THE FISHERY

The fishery has been threatened in the past by outsiders. East coast oyster fishermen invaded the fishery in the 1840s to the detriment of the local inhabitants and fishers. They ignored rules intended to protect the fishery and fished through the summer closed season, protected from the wrath of local fishers by three of Her Majesty's cutters and 40 marines (Davies 1995: 172). The risk of invasion has since declined and Davies (1995: 172) states that:

As long as the rule of 'sail only' applies on the Truro fishery, we are surely safe from the predatory attentions of the East Coast men for all time, whose sailing smacks are only museum pieces, unlike the Falmouth Working Boats which are still earning their keep in the manner for which they were built.

A more recent threat to the fishery came in the form of a European Union rule requiring the registration of all fishing boats 10 metres in length or less. Compliance would have involved considerable expense and fitting of unnecessary equipment. Possibly the intent of such rules is to force "inefficient" small-scale fishers out of business to protect the viability of more highly capitalised operators from competition. Fortunately for the Truro fishery the rule was overturned after the British Prime Minister intervened (Davies 1995: 3-4).

Other threats to the fishery include pollution, disease, weed growth, siltation of the oyster beds and adverse effects as a result of developments within the port or catchment (Davies 1995: 3-4). The dredgers are few in number and are aware that their fishery is vulnerable and that they have very little real political influence to protect it should conflicting vested interests eventuate. The destruction by industrial fishing of the Cornish mackerel fishery in the early 1980s was a stark reminder of the power of commercial interests. Despite the protests of thousands of local Cornish mackerel fishers a fleet of factory vessels from many nations was allowed access to the stocks. It was not until the fleets had made their profits and moved on, leaving behind a severely depleted fishery, that the government belatedly banned fishing for mackerel by methods other than handlining (Davies 1995: 229). Vessels with a crew of 15 and capable of catching in a day as much as a fleet of handliners employing 40 fishers would catch in 10 weeks, had been allowed to damage the fishery and jeopardise the means to a living of thousands of small-scale fishers (Davies 1995: 229). One could argue that the factory vessels were a more efficient way to harvest the resource. But their use did not contribute to sustaining it, or to the social and economic well-being of the Cornish community.

4.4 NORWAY'S COASTAL FISHERIES

The European Union's (EU) fishing grounds are seriously depleted following decades of overfishing by overcapitalised fleets. This is a legacy of generous subsidies to shipbuilding without regard to the ecological capacity of fisheries to sustain the fishing effort. Addressing the problem of overcapacity requires that the EU fleet be reduced by 40 percent (Anon. 1996b; Holmes 1996) and catches cut significantly over six years to allow stocks to rebuild. A proposal to this effect confronted the immediate interests of the fishing industry and met strident opposition from fisheries ministers from the various EU fishing countries (Anon. 1996b; Holmes 1996). Achieving the adjustments needed to rehabilitate EU fisheries will not be easy.

The coastal fisheries of Norway are in a far better state than those of the EU and are better managed (Anon. 1996b). Many Norwegian communities depend heavily on fisheries for their economic well-being and have a long cultural heritage associated with fishing. Fear of losing control of their fisheries to the EU was a significant reason why Norway voted against joining the EU in 1994 (Anon. 1996b; Wise 1996: 143).

Norwegian fisheries have faced crises in the past. In the 1980s cod stocks were depleted but they have since been rebuilt. This was possible because the political, social, technical and economic conditions conducive to conservation and sustainable management were attributes of Norwegian society and its fishing industry. Mariussen (1996: 27) points out that the Norwegian fishing industry is dispersed among family firms embedded in small rural communities, in contrast to the fishing industries of most EU countries which are organised in urban centred, capital intensive, agro-industrial type operations.

Norway has an extensive and rugged fjord coastline, and many communities have a tradition of combining small-scale fishing with agriculture (Jentoft and Mikalsen 1994: 290). Most Norwegian fishing boats are small, are operated by one or two fishers, and have a limited capacity to impact on fish stocks. Of Norway's fleet of 17 000 fishing vessels only 500-600 are ocean-going ships (Anon. 1996b). Jentoft and Mikalsen (1994: 290) note that: "Historically, the fjord fisheries for cod have been the exclusive domain of the local population, which uses traditional gear such as hand lines, longlines, and gill-nets."

The advent of new technology, particularly trawls and purse seines, has been seen as a threat to traditional fjord fisheries (Jentoft and Mikalsen 1994: 292). Since the mid-1950s fjord communities have continuously sought to protect their local fisheries by calling for restrictions on the use of trawls and purse seines by "intruders". These calls have been resisted by the national administration which favours "open access" to fjord

fisheries and maintaining fjord fisheries as "common property" rather than "exclusive assets of the local population" (Jentoft and Mikalsen 1994: 294). But gear restrictions are enforced where necessary for conservation of the fishery resource (Jentoft and Mikalsen 1994: 292-293).

While "open access" has been the official position, it has only applied to Norwegian vessels. Norway's fishers have not seen their coastal waters invaded by huge, foreign owned, factory vessels such as those that depleted the Cornish mackerel fishery. The ability to exclude these vessels is one of the advantages of non-membership of the EU (Anon. 1996b). Norway has some large fishing vessels of its own but they have not been allowed to fish indiscriminately in Norway's coastal waters, an approach similar to Kalland's (1996: 77) observation that in the fisheries of coastal Japan, inshore waters are reserved for "low efficiency" small-scale fishing vessels. Large vessels have been controlled by the Norwegian management system which has included local fishing interest representation and is characterised by wide participation of user groups and a regional focus (Jentoft and Mikalsen 1994: 289). Jentoft and Mikalsen (1994: 309) note that local non-fishing interests are underrepresented in decision making, but generally the Norwegian system affords greater opportunities for participation and for regional interests to have some influence than is the case in the more centralised EU fisheries (Phillipson 1996; Symes 1996: 11). Symes (1996: 11) notes that:

The 'negotiation economies' of Denmark and particularly Norway have provided opportunities for the strong representation of the resource users' views in the consultation procedures which precede policy decisions - somewhat in contrast to the centrally managed policy formulation in the UK.

Almost all of Norway's fishers are members of one national union (Anon. 1996b). The majority of these are small-scale fishers, but they are many in number and this, along with the strength of the union, ensures that their interests have the political weight to be represented in the management of coastal fisheries. Local branches of the union have influence in protecting the interests of small-scale fishers at the regional management level (Jentoft and Mikalsen 1994: 292-293), and at the national level the union has the strength to influence policy. The strength of the decentralised coastal fishers' influence was instrumental in their effective resistance to an attempt by the Norwegian Government to impose a quota management system that might have favoured the interests of the industrial fleet (Hersoug 1996: 23).

Participation by fishers in the management process enhances legitimacy and there is close cooperation between Norway's authorities and fishermen. As a result agreements

tend to be honoured and there is a high level of compliance with regulations (Anon. 1996b).

Norway's fisheries and its small-scale fishers have been protected from excessive capital involvement in the industry by a number of regulatory measures that were felt necessary to protect Norway's regionalised social and economic development (Wise 1996: 144). A Norwegian may not own a fishing boat unless he or she has been an active fisher for three of the past ten years (Anon. 1996b) and there are restrictions on the vertical integration of ownership of fishing vessels and processing plants.

4.5 DISCUSSION - EQUAL ACCESS AND INEFFICIENCY

Pinkerton (1989: 3-33) discusses the benefits of user participation and a local orientation in fisheries management decision making. Local involvement and fisher participation in management decision-making is an attribute of the three fisheries. In the case of the Truro oyster fishery the local government corporation is the management authority. In Buen Hombre the local fishermen's association makes rules to conserve and manage the fishery and has been granted legal authority to enforce them. In the case of Norway's coastal fisheries, management decision-making involves national, regional and local government, and the involvement of regional branches of the national fishermen's union with representatives from the different user groups. Widespread participation in decision-making is instrumental in establishing the legitimacy of regulations in the eyes of fishermen and this results in widespread voluntary compliance, supported by unified social pressure to encourage observation of the rules.

The localised focus of management allows the establishment of management regulations and practices that are appropriate to the specific environmental conditions and social needs of fishing communities. This may lead to better outcomes than situations where decision-making is highly centralised and a uniform set of regulations is applied over vast and diverse areas, regardless of localised differences and specific needs and problems.

While local and participatory decision-making is of prime importance there is still an important and quite complex role for central authority. The higher authority of the national governments can provide an important source of legitimacy and empowerment to locally derived management solutions by backing up enforcement of local regulations. This was clearly instrumental in the successful expulsion of fishers using illegal *chinchoro* nets by the fishers of Buen Hombre.

However central government is often reluctant to cede too much power or control over the use and distribution of resources to local communities. Doing so goes against the

fundamental instincts, interests and imperatives of the state as an institution of centralised power. To maintain sovereignty, the state has to resist the desire of local regions or communities to gain rights of exclusive access, use and control over local fisheries. There is evidence for this in Norway's national level policy of maintaining "open access" to coastal fisheries in opposition to pressure from local communities who would prefer exclusive rights. In the 1840s the British navy enforced "open access" to the Falmouth oyster fishery and a navy cutter protected fishermen from distant ports while they plundered the resource under the noses of the outraged local community. This happened after the local fishers had in effect "gone out on strike" in response to the low prices that London merchants were offering to pay for their oysters. In the case of Buen Hombre, while the local fishers would probably prefer exclusive rights to the fishery, this seems not to be an option. Stoffle *et al.* do not mention whether national policy provides for open access, but a local fisher named Tuba is quoted (Stoffle *et al.* 1994: 129) as saying: "We accept people coming in and fishing in our territory, but we do not want people who will come in and hurt the marine environment. They need to fish in the same way as the fishermen of Buen Hombre".

This implies acknowledgment by the fishers of the legitimacy of open access to the resource. This common feature of the three fisheries may be a key factor in their sustainable management. It is significant because it seems to be a direct contradiction of that widely accepted tenet of resource management, that "open access" must inevitably lead to ruin and that "open access" is the essential cause of many fisheries' failures. To argue that defending a policy of "open access" contributes to achieving ecologically sustainable resource use invites controversy to say the least.

The fishers of Buen Hombre, the River Fal and the inshore coastal fisheries of Norway have been unable to exercise proprietary rights over their local fisheries. They all are threatened, or have been threatened, with competition for access to their local resources by the invasion of fishers from outside the community or local region. Unable to exclude other people from sharing access to the resource, they have responded by imposing restrictions on the technology that may be used in order to protect their local fisheries from overfishing. Jentoft and Mikalsen (1994: 292) point out that coastal fjord fishers have persistently called for ever tighter restrictions to limit the use of more powerful fishing technologies in their coastal waters. The local Buen Hombre fishers deny themselves the use of more effective fishing technologies such as nets and compressors and crusade against their use by others (Stoffle *et al.* 1994: 131); and in the Truro oyster fishery, the validity of the no-motor rule rests on a local by-law, and the "inefficiency" it imposes on all is staunchly defended by the local fishers (Davies 1995: 230).

The restriction on gear efficiency may be the most important single factor contributing to the sustainable management of these fisheries. The policy of "open access" is the key to promoting acceptance and enforcement of gear efficiency constraints by fishers with no other means to limit depredation of their local resources by outsiders. This, and the need to maintain the integrity of the rules as protection against outsiders, protects the resource from depredation by local fishers. External pressures may provide the cohesion and social responsibility that prevents local fishermen from cheating, or the locally powerful from monopolising the resource for their individual benefit. Where a policy of "open access" to fisheries provides the essential motivating force for the imposition of technology constraint in a fishery, then it may be a vital, albeit indirect key, to the sustainable management of those fisheries.

Restricting the gear and technology that may be used means that these fisheries cannot strictly be considered "open access". While people may freely access the resource, they may only do so subject to the constraints that are imposed equally on all. This may enhance the legitimacy of regulation; Vestergaard (1996: 89) observes that there is less resistance to technical regulations than to those that are distributional, such as licences and quotas. The restrictions apply to technology and by extension to capital. Instead of "open access", a better description for these fisheries might be "equal access".

Equal access efficiency-restricted fisheries do not strictly provide equal opportunities for all. They favour local fishers over outsiders because they are likely to have better knowledge of local fishing grounds. The intellectual property of knowing how, when, and where to fish may be "owned" by the local fishing community, thus giving them an advantage over outsiders who might be able to use capitalised technological fishing inputs more competitively, but who are not permitted to do so. This can also promote wealth equalisation among fishers and more widely in the local community by emphasising human inputs rather than capital inputs in the production process, thus providing for wider community involvement and interest in the well-being of the fisheries.

5. CONSERVATION AND ECONOMIC EFFICIENCY

5.1 CONSERVATION AND INEFFICIENCY

5.1.1 FISHERIES EQUILIBRIUM YIELD

The basic economic model for fisheries is the open-access equilibrium yield model (Anderson 1977: 30-31; Roberts 1997). The model is a theoretical construct combining the biological response of a fish population to increasing levels of predation or fishing effort, and the response of fishing effort to the economic effects of different levels of abundance of the target fish species. The economic foundations of the model were described by Gordon (1954) and Scott (1955) and it is commonly used to illustrate the inevitability (in theory) of over-fishing in an open-access fishery (Anderson 1977; Arnason 1993; Roberts 1997). Despite practical limitations as a predictive tool in fisheries management due to its inability to account for the complexity and inherent instability of the oceanic environment (Kesteven 1997; Wilson *et al.* 1994; Symes 1996:6), the equilibrium yield model is nevertheless a useful tool to explore conceptually, issues relating to economic efficiency and their biological consequences to a fishery.

The biological component of the model is the surplus yield curve that illustrates the yield from a fishery subjected to different levels of fishing effort (Figure 5.1). Arnason (1993) describes the theory of the model. At low levels of fishing effort the population is not being harvested to its full biological potential and increasing effort will result in a higher catch. Incremental increases in the amount of effort result in a larger catch until the point of maximum sustainable yield is reached. Beyond this point further increase in effort yields a reduced catch because it depletes the population below the level of maximum productivity. If fishing effort is further increased it could eventually reach a point where it causes population extinction.

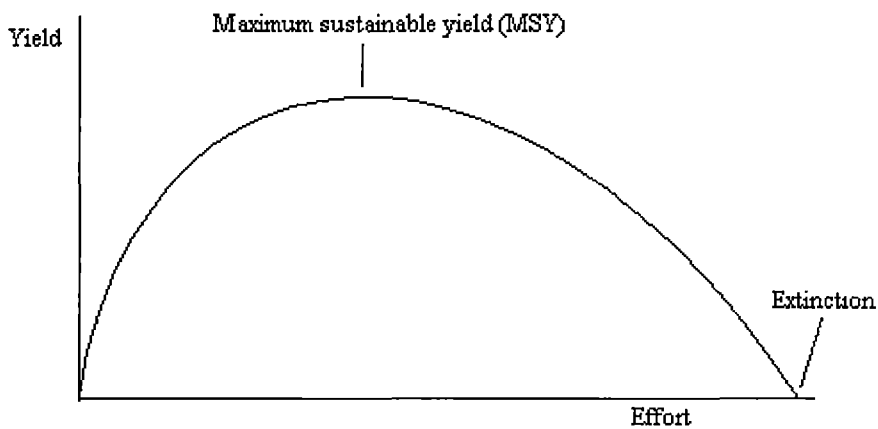


Figure 5.1 Standard surplus yield model: relationship between yield and effort.

The standard equilibrium yield model is developed by adding an economic dimension. The value of fish is assumed to be proportional to the amount caught and the cost of increasing amounts of fishing effort is added to produce a cost dimension to the model. This is generally illustrated as a straight line assuming a proportional increase in the cost of incremental amounts of fishing effort (Figure 5.2).

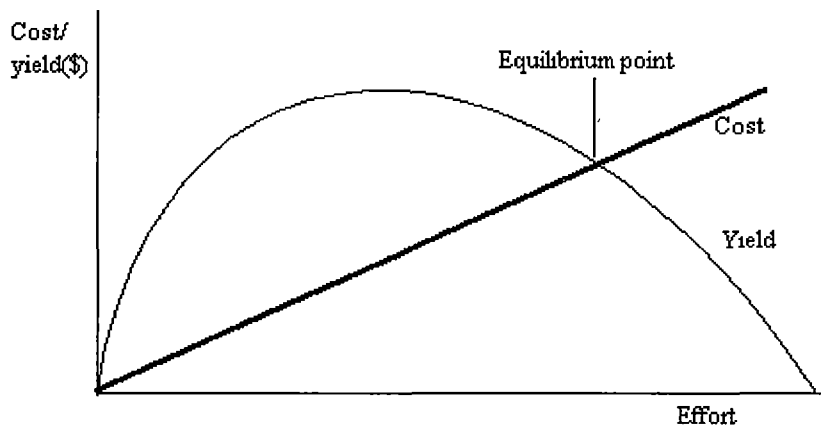


Figure 5.2 Standard equilibrium yield model.

The total profit being produced from the fishery is the difference between the value of fish caught and the cost of fishing effort required to make that catch. In an "open access" fishery there will be a tendency for effort to increase to the equilibrium point. More capital and more labour will have an incentive to enter the fishery as long as it is profitable for it to do so, that is until the equilibrium point is reached where the cost of a unit of fishing effort is equal to the value of the fish captured by that unit. An additional unit of effort would cost more than the value of the fish it would harvest so there would be no profit incentive to motivate that extra unit of effort to enter the fishery. At the

equilibrium point there is no surplus, profit or resource rent generated from the fishery. This would be considered as economic over-fishing if maximising profit or resource rent was a management objective.

5.1.2 CHANGES TO THE EFFICIENCY OF FISHING EFFORT

If the efficiency of fishing effort is increased, that is its effectiveness relative to cost, perhaps as a result of the introduction of more efficient harvesting technology, then the cost curve will be lowered as the cost per unit effort is reduced, and the equilibrium point on the model will shift to the right in the direction of over fishing (Figure 5.3).

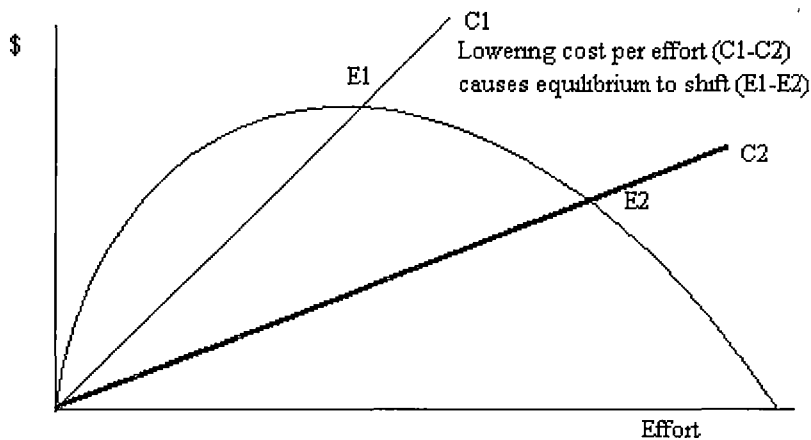


Figure 5.3 Effect of lowering the cost of fishing effort.

If maximum sustainable yield (MSY) is the desired outcome, lowering the cost per unit effort will not necessarily lead to over fishing. It could result in an increased yield from the fishery if the previous equilibrium point was to the left of the point of MSY (Figure 5.4) and the improved efficiency might be seen as beneficial.

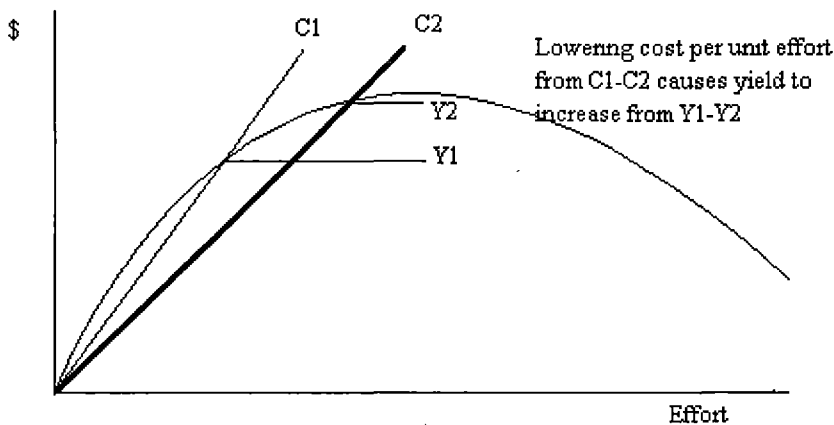


Figure 5.4 Effect on yield of lowering cost of fishing effort in underexploited fishery.

5.1.3 JUSTIFICATION FOR EFFICIENCY CONSTRAINT

If the fishery was already over-exploited with regard to MSY, however, then the effect of an increase in the efficiency of fishing effort would be a reduction in the yield from the fishery. In such a situation, if efficiency was constrained, perhaps by management imposed regulation, the cost curve would be raised and the equilibrium point pushed to the left towards the point of MSY, thus the yield from the fishery could be increased (Figure 5.5). This is the theory that provides justification for the use of efficiency constraining input controls in fishery management. This illustrates the benefits of what Davies (1995: 230) describes as managing by inefficiency, the key to the sustainable management of the Truro oyster and the Buen Hombre fisheries and an important component in the sustainable way that many fisheries around the world, including traditional, artisanal, commercial and recreational fisheries, have been used or managed since the beginning of time. This efficiency constraint has often been achieved as a result of maintaining traditional practices by fishing communities who recognise its value to maintaining resource security. It can be the consequence of the lack of technology with the power to achieve greater harvesting efficiency, but is often brought about by formal management decision making to serve conservation and social objectives, including provision of employment opportunities and wealth equalisation in the community.

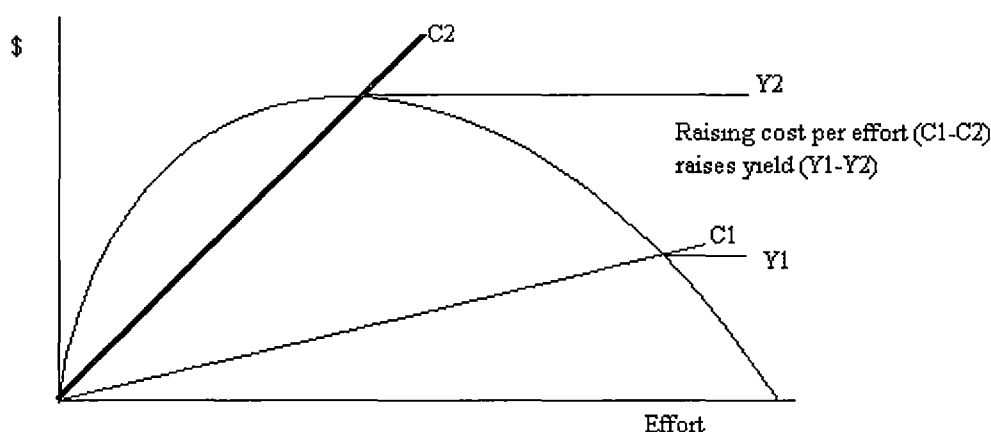


Figure 5.5 Effect of efficiency constraint on yield in overexploited fishery.

In addition to the possibility of raising the yield from the fishery in an "open access" equilibrium situation, efficiency constraint also tends to reduce the risk of biological fishery collapse through overfishing because it tends to reduce effective fishing effort overall. In addition, because the cost curve of an efficiency constrained fishery is steeper, it is likely to be more sensitive to changes in catch per unit effort that may occur as a result of fluctuating fish populations. If, for example, the population of the target species were to fall to below the "normal" level, perhaps in response to environmental

conditions or some other factor, and the catch per unit effort was consequently reduced, the proportional reduction in catch is greater in the efficiency constrained fishery with the steeper cost curve as illustrated in Figure 5.6.

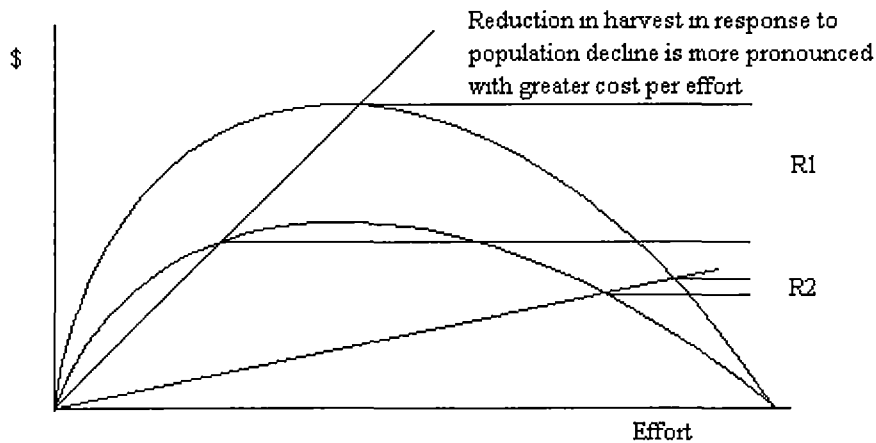


Figure 5.6 Sensitivity of effort to stock fluctuations.

The greater sensitivity of the efficiency constrained fishery to a reduced fish population is likely to cause a more effective response in reducing fishing effort and allowing the population to recover. This negative feedback mechanism promotes biological equilibrium and stability, with its function similar to the ecological feedback mechanisms that regulate many predator prey relationships in nature, unlike the financial budgets that usually take the place of energy budgets in fisheries with human predators.

According to this model of an open-access fishery, regardless of the level of efficiency, there is no potential to generate resource rent or profit on a sustained basis. Fishers on average will earn sufficient to compensate them for their costs, their labours and their skills, but no more. If they made more than a moderate profit, then, according to the rationale of the theory, fishing effort would increase in response to the opportunity, as the profit potential would attract new participants into the fishery. This would reduce the population of fish and lower catch per unit effort until there was no longer any profit and the equilibrium was restored.

Fishermen earn a reasonable return on their labours relative to other options that may be available to them, but no profit beyond this. If efficiency-constraining input controls are used in order to raise the cost curve and thereby achieve an increased level of sustainable yield, individual fishers may gain little direct benefit in the long run, as they still only earn wages, but if the community is small and the fishery is a significant part of the local economy, then the increased productivity may raise the wages of the entire

community, including the fishers. There may also be benefits in terms of resource security. If there is reduced overall fishing effort this may mean less risk of resource collapse from overfishing.

The communities to which fishers belong may benefit from raising the yield of the fishery and from increased employment opportunities if the increased costs of fishing effort were due to constraints that made the industry more labour intensive. This may provide more jobs in regions lacking other employment opportunities or non-wage benefits to those fishers who enjoy fishing as a lifestyle but who would be forced into other occupations if less labour intensive fishing methods were employed. Because there is no substantial profit in the fishery there is no need for barriers to entry. Equal opportunity of access to the fishery has a wage equalising effect within the community. If the fishery is productive the benefits flow and contribute to the prosperity of the entire community. If the harvest is bad, all are affected. This creates a community-wide shared incentive to protect and conserve the fishery.

In an equal access fishery where the potential exists as a consequence of the availability of efficient harvesting technology for biological overfishing to occur, efficiency constraint may be seen, not as an impediment to achieving prosperity, but as an aid to achieving maximum sustainable well-being yield from the resource and maximising the sum well-being of individuals within the community. This benefit to the wider community can encourage and legitimise the observance and enforcement of input controls that limit harvesting efficiency. It establishes a moral imperative for individual fishers to observe the rules for the good of their fellow fishers and the good of the rest of the community. This moral imperative is important for there is still the possibility for individuals to obtain profit by cheating, by fishing in ways that circumvent the rules that serve to constrain efficiency. Imposing equal restrictions on all is also likely to be important in order that restrictions are seen as fair. Management regimes that allow some fishers to use more gear than others may undermine this source of moral legitimacy for the rules.

If the benefits of observing efficiency constraints are recognised in a particular fishery, there is the opportunity to devise constraints that contribute further to the productivity and well being of the fishery. Efficiency constraint in itself contributes to resource conservation by removing the profit incentive that often causes overfishing, but the benefit to sustainability can be compounded when the constraint is achieved in ways that minimise disruption to the productivity of fish populations and the wider ecosystem processes that sustain them.

Most management imposed input controls are intended to work in this way, limiting the use of wasteful or damaging gears, protecting stocks during critical periods such as breeding seasons, or by imposing size- and sex-related harvesting selectivity where appropriate. It is also possible for governments to raise revenue from a fishery in such a way as to act as an efficiency constraint. Taxes on fuels used in fishing vessels would impose a cost that related closely to effort, and fees or a royalty charge based on the amount of fish caught would indirectly have the same effect.

The important point from all this is that if access to the fishery resource is open to all, conservation through restraint on the efficiency of fishing effort does not necessarily impose economic sacrifice on the fishing community, but can contribute to greater total productivity and community prosperity.

5.1.4 FAILURE TO PRODUCE RENT

Efficiency constraint in an "equal access" fishery may overcome the problem of biological overfishing and resource depletion that could otherwise occur, but the obvious economic failing of this model is that it does not produce resource rent. All the potential rent or profit from the fishery is dissipated in fishing costs, including income to fishers. Arnason (1993) notes that this "economic inefficiency" of competitive, free access fisheries was not a matter of concern until the 1950s when it was pointed out by Gordon (1954) and Scott (1955). If more "efficient" fishing methods were used, and overfishing prevented by limiting catch and effort below the equilibrium point, then the sustainable yield from the fishery could be maintained, and this yield could be achieved at less cost than if the same effect were produced by efficiency constraint. Thus an economic surplus can be produced. This surplus would in theory be maximised by constraining the catch somewhat to the left of the point of maximum sustainable yield (MSY) where the difference between the cost and yield curve is greatest (Figure 5.7.). The maximum rent is produced at the point where a line parallel to the cost curve intersects on a tangent with the yield curve. An economic incentive to reduce catch below MSY is arguably a conservation plus.

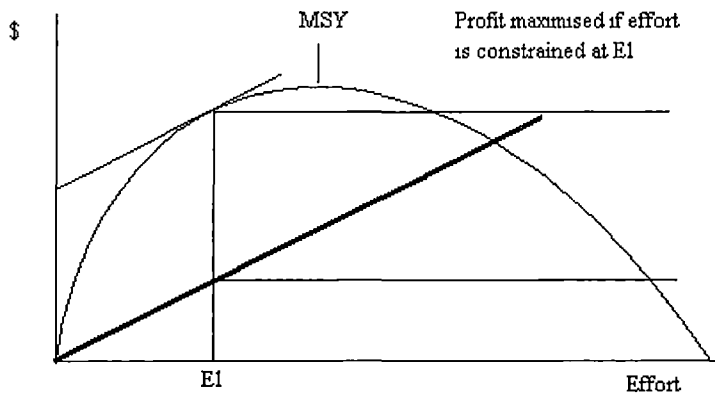


Figure 5.7 Maximising Resource Rent

Managing a fishery to maximise rent production requires regulation to limit catch and effort. This can be achieved by management strategies involving the allocation of catch quotas. Policing is generally necessary to prevent fishers from responding to the economic incentive to increase effort. Enclosure, essentially privatising fisheries that might otherwise be community resources, is often a component of management for economic efficiency in terms of rent production.

In managing to maximise rent the functioning of ecological feedback mechanisms is reduced. Efficient and potentially damaging technologies may be used to harvest the resource at the lowest possible cost. This may have more severe impacts on marine environments and create a situation of greater risk of overfishing. Conservation is reliant on managers setting and effectively policing appropriate levels of catch and effort. There is no longer a natural balancing mechanism to reduce the risk of biological collapse of the fishery, and as Anderson (1977: 41) points out, economic discounting provides an incentive, even for a single resource owner with certainty of property rights, to harvest at higher levels than would appear optimal. At a very high discount rate, this optimum level approaches the open access equilibrium levels of catch and effort. If efficiency constraints have been removed this equilibrium level may represent overfishing and pose a threat to the biological sustainability of the fishery, and if, in the interests of efficiency, the use of potentially destructive and wasteful technologies has become established, the risk of environmental damage is increased. Doubts about the security of property rights, perhaps due to social tensions resulting from unemployment, would have the effect of increasing the discount rate because of the risk of loss of control of the resource.

5.2 ECONOMIC EFFICIENCY - A MATTER OF PERSPECTIVE

One cannot advocate managing fisheries by equal access and efficiency constraint, rather than by enclosure for rent production, without addressing the issue of economic

efficiency. Is rent production necessary for a fishery to be economically efficient? It all depends on one's perspective. Some economic assessments of fisheries consider the economic surplus, or resource rent produced after subtracting total fishing costs from the value of the catch, to be the only net economic benefit of a fishery. Fishing costs, including wages to fish workers, are seen to detract from economic performance. This view is not a value-free assessment of economic performance. It measures economic performance from the very narrow perspective of those who stand to appropriate the rent. It often has nothing in common with a more holistic understanding of the economic benefits of a fishery to a society or to other social well-being benefits associated with the fishery.

5.2.1 ECONOMICS OF RECREATIONAL FISHERIES

Recreational fisheries provide a good argument against the position that fisheries should produce rent in order to make a positive economic contribution to a society. Recreational fishing is usually managed to ensure that it is extremely inefficient. Gear restrictions are generally quite severe. Fishers may be limited to the use of rod and line, or if other gear such as nets, traps or pots is permitted, the quantity is generally limited to prevent its use contributing to an economically viable operation. Bag limits further restrict economic opportunities for recreational fishers and often it is illegal to sell fish taken by recreational fishing. This prevents any legal economic use being made of the catch other than its use for personal consumption, and even this is often discouraged and "catch-and-release" promoted in the interests of conservation. All of these measures, these constraints on the economic efficiency of recreational fishing, mean that in terms of commodity production, there is no economic rationale for people to engage in it. Nevertheless, many people obviously gain something from recreational fishing other than the commodity value of the catch and are prepared to spend a great deal of money and other resources in this pursuit. They purchase licences and equipment, including tackle, boats and vehicles to tow them. They buy fuel and pay for accommodation, guides and other services related to fishing activities; and all of these costs are lauded as the economic benefits that recreational fishing contributes to society. Unckles' study (1997) into the economics of recreational fishing in Victoria estimated that \$1.037 billion was spent annually on these pursuits, amounting to \$200 per kilogram of fish caught. This was believed to generate 27 000 jobs and contribute \$830 million in income to Victorian households.

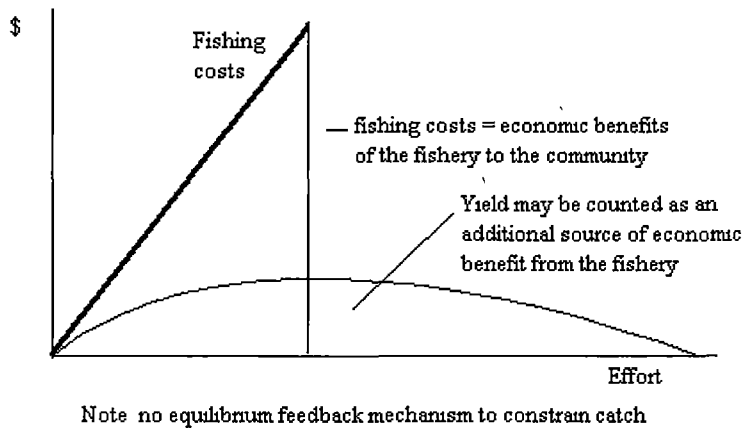


Figure 5.8 Recreational fishing costs: the economic benefit to society.

It is the costs associated with fishing that are seen as the economic benefits of the activity (Figure 5.8). The commodity value of the fish that are taken may be counted as an additional economic benefit, or alternatively as an environmental cost, something that is better kept to a minimum. This view of costs and benefits is exactly opposite to that which is generally applied to commercial fishing operations. If the costs associated with recreational fishing provide the economic benefit of the fishery to the community, then surely the corresponding costs associated with commercial fishing should yield corresponding economic benefits; and of course they do. Indeed many commercial fisheries have been managed primarily to generate economic activity associated with fishing costs, especially capital costs associated with vessel construction to support shipbuilding industries, and this has often led to overcapitalisation and been to the detriment of the fisheries. Just as excessive efficiency can lead to overfishing, so can subsidised inefficiency.

5.2.2 A SOCIAL AND POLITICAL PERSPECTIVE

There is an apparent contradiction between the objectives of management of a commercial fishery to maximise economic efficiency in terms of resource rent, and the objective of management of a recreational fishery for maximum inefficiency in order to maximise the generation of secondary economic benefits. This contradiction is most evident when both fisheries operate side by side in the same location, using a similar type of gear and targeting the same species, as is the case with Tasmania's rock lobster pot fishery. In this fishery, management has allowed increased efficiency in the commercial sector while restrictions on the recreational sector have been tightened. Understanding this apparent contradiction in efficiency-related management objectives reveals a social/political function of management.

Efficiency is a matter of perspective. One person's costs are another person's benefits. There are a lot of conflicting interests in the economy of a fishery. While fish workers

may benefit from the costs associated with paying their wages, these costs detract from the production of profits or rents for resource owners (some of which may be shared with the state through taxation). A local community may benefit from fishing-related costs spent on the services it provides, but gain no benefit from resource rents that can be taken out of the locality. Benefit from the production of resource rent goes to those who can appropriate a share of it. Governments generally maintain themselves on the surplus of economic activity that they can appropriate through taxes or other means, and government and capital-based "owners" are generally joint beneficiaries of resource rents produced.

Managing a commercial fishery for rent production helps to maintain the value of capital assets, such as the "property" value associated with fishing entitlements. This contributes to maintaining the social order where capital is the basis of power and status in society. Managing an "open access" recreational fishery to be inefficient serves the same purpose. While the fishery may serve as a resource to provide for various recreational, cultural and spiritual needs, it does not serve as a direct economic resource. Common people cannot gain economically through the avenues of access to the resource that the regulations allow. Instead they are encouraged to dissipate their personal wealth on consumer products such as boats, motors, electronics, fishing tackle and the use of fossil fuels, thereby contributing to sustaining the value of capital involved in producing these goods, and to the state that obtains taxes and revenues from their production and consumption. By dissipating the wealth and therefore also the power of ordinary citizens, recreational fisheries that are managed to maximise inefficiency may also contribute to maintaining the social order.

Managing fishery resources for economic efficiency measured as the production of resource rent can therefore be seen as having a political purpose. Maximising the value of capital assets associated with the fishery, including the property rights attached to fishing entitlements, does not necessarily serve the values associated with ecological sustainability and it has nothing to do with ecological efficiency. Indeed it is often incompatible with a holistic consideration of economic efficiency from the wider perspective of the entire community rather than the more narrow perspective of serving the vested interests of a particular group of stakeholders. Economic efficiency that merely serves to maintain inequality in society is not compatible with the values associated with ecologically sustainable development discussed in chapter 1. It is important to recognise that economic efficiency defined in terms of production of resource rents and profits, is a political objective. It is about competition for power within a society, and is often at odds with the objective of maximising the economic benefit of the resource to the wider community. Understanding this brings into question the principle economic argument against efficiency-constrained, equal access fisheries.

5.2.3 A HOLISTIC PERSPECTIVE ON EFFICIENCY

That does not mean that efficiency has no place in the discussion of ecological sustainability, but a different view of efficiency is needed, a more holistic approach, based not on maximising the benefits of resource use to favour the interests of one group over another, but on maximising social well-being benefits and the values inherent in the concept of ESD. This view of efficiency might focus on minimising the costs of resource inputs, including the use of fossil fuels, and consider environmental spillovers. It should also consider non-economic well-being issues related to quality of life and include consideration of the value of providing increased choices and opportunities for employment. It should recognise as a benefit to the community, the socio-economic equalising effects of providing equal access to economic resources. And it should consider the well-being benefit to individuals and communities of freedom from economic dependency and the burden of debt due to overcapitalisation of local production processes.

This approach to efficiency might be furthered by reducing the distinction between commercial and recreational fisheries. If the principle of equal access were applied, efficiency constraint would be needed to reduce the fishing power of the commercial sector to prevent over-fishing. The profligate wasting of resources in both the commercial and recreational fisheries could be discouraged. Many environmental costs such as spill-overs associated with the use of fossil fuels and other inputs might be addressed by taxation. Imposition of appropriate efficiency constraints might cause the fishery to resemble a traditional operation such as the Truro oyster fishery and the artisanal fisheries still common in many less affluent societies constrained by poverty from the profligate wasting of resources that occurs in those industrialised fisheries where political goals have precedence over ecologically efficient production of material and well-being needs.

5.2.3.1 Artisanal Fisheries

McCully (1991) compares characteristics of industrialised and artisanal fisheries in a critique of policies of the Food and Agriculture Organisation of the United Nations (FAO) that promote the "modernisation" of fisheries. He also highlights the contradictions between expressed policy goals of providing help to further the well-being of poor fisher folk, and the outcomes of "modernisation" which include increasing income disparities in fishing communities, overfishing and the "marginalization and impoverishment of traditional fishing communities around the world" (1991: 77).

McCully presents some statistics on artisanal and industrialised fisheries from *Food Matters Worldwide* 8, October 1990, that provide an opportunity to reflect on the issue of efficiency (Table 5.1).

Table 5.1 Comparison between industrial and artisanal fisheries.

	Industrial	Artisanal
Number of fishers employed	c.450,000	c.15,000,000
Catch for human consumption	c.25mt p.a.	c.20mt p.a.
Capital per fishworker	\$10-100,000	\$100 - \$1000
Catch for fish by-products	c.19mt p.a.	virtually nill
Fuel consumption	10-14mt p.a.	1-2mt p.a.
Catch per tonne of fuel	2 - 5 tonnes	10 - 20 tonnes
Jobs per \$million invested	10 - 100	1000 - 10,000

(Source: Food Matters Worldwide 8, October 1990, cited in McCully 1991: 79)

If one thinks of efficiency in terms of the values of ecologically sustainable development for fisheries, efficiency in terms of maximising opportunities for employment from a limited resource base, of minimising the use of fossil fuels, and reducing the diversion of fish to low value uses such as for reduction for stock feeds, then the artisanal sector is more efficient. McCully also points out that there is virtually no waste of discarded by-catch in artisanal fisheries and the fishing technologies employed cause less habitat damage.

However, artisanal fisheries afford less opportunity for the involvement of capital and for the small percentage of the global community who own most of it to appropriate a share of the wealth of the fishery resource. Artisanal fisheries are inefficient from the perspective of capital and of capital-rich elites wishing to promote the use and involvement of capital over that of labour in the production process.

5.2.3.2 Overcapitalisation

Overcapacity is perhaps the greatest threat to the sustainability of global fisheries (Mace 1997: 4). Overcapacity means too many boats and too many fishers, and overcapitalisation focuses on the aspect of too many boats and too much capital investment. Figure 5.9 illustrates the effect of overcapitalisation and capital subsidy in commercial fisheries, using a modification of the equilibrium yield model. It also demonstrates the problem associated with capital intensive fisheries where, although fixed costs are high, marginal fishing costs are relatively low, resulting in a cost curve with a low gradient. This is compared to a low capital cost/high marginal cost fishery with a steep cost curve which is more sensitive to efficiency-related ecological feedback (Figure 5.10).

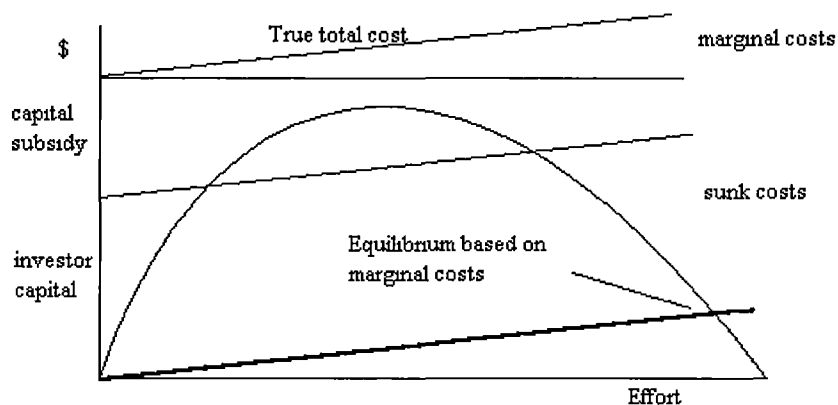


Figure 5.9 Effect of overcapitalisation of fisheries

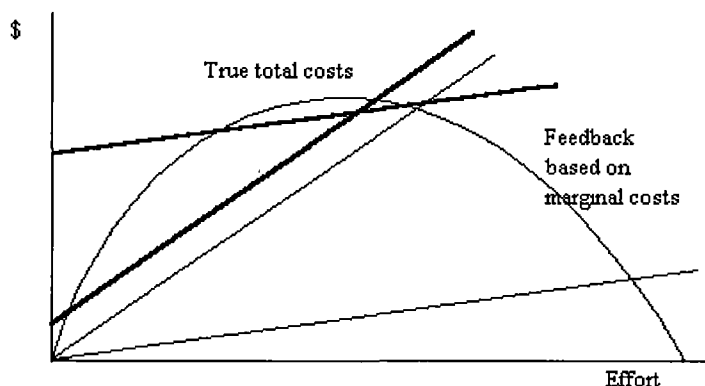


Figure 5.10 A comparison of a high capital/low marginal cost fishing operation with a low capital/high marginal cost fishing operation.

Overfishing by capital intensive industrial fisheries is a particular problem because the decision on when to stop fishing is often based on marginal costs of fishing which may be relatively low. Capital costs, the value of vessels and equipment, and licences where access to the fishery is based on tradable property rights, are usually sunk costs and once incurred have little influence on day by day surplus-maximising decision making. This can mean that fishing operations continue even though they make a net loss if capital costs are taken into account. Mace (1997) cites FAO (1993) estimates that income from global fisheries of US\$70 000 million in 1989 were offset by total costs in excess of US\$124 000 million. In other words global fisheries made a net financial loss of US\$54 000 million. Mace (1997: 6) argues that economically marginal fishing operations are less likely to conserve stocks because they cannot afford to forego income today in order to provide for the unguaranteed possibility of future profits. They cannot afford to sacrifice earnings by fishing in ways that minimise environmental damage and reduce

bycatch and discarding. This may be so in highly capitalised fisheries; but where fishing costs are predominantly marginal costs rather than sunk capital costs, such as in the Buen Hombre fishery and in the Truro oyster fishery, this is not the case, and economic marginality is the mechanism for effective conservation.

Overcapacity may develop in recreational fisheries if fishers are encouraged, in the interests of greater economic throughput, to purchase vessels equipped with powerful motors and sophisticated electronic fishing aids. This can lead to over-fishing where the efficiency of fishing activity becomes divorced from ecological feedback mechanisms. However recreational fishers may be more responsive than the commercial sector to calls for restraint in the interests of conservation, because, perhaps, they are largely motivated by other than material values. It is also likely that the "equal access" nature of most recreational fisheries establishes a moral legitimacy for conservation measures that will be of benefit to all and will not merely serve to enrich and empower a less inhibited competitor for the resource.

5.2.4 A REGIONAL PERSPECTIVE

There is also a regional dimension to the issue of efficiency. Arrangements that favour the consolidation and removal of resource wealth from a region may seem favourable and efficient to those who live elsewhere and stand to benefit, but would be inefficient from the perspective of those who live locally and would benefit more from the dispersal of resource wealth in their region. Efficiency-constrained artisanal fisheries may be more efficient from a regional perspective for several reasons. Local fishers may have an advantage over "outsiders" due to better knowledge of local fishing grounds and reduced costs of travel to access the fishery. If the fishery is economically marginal it may only be viable for local fishers to work it. Regional fishing communities often benefit if fishing inputs emphasise local content, especially labour, rather than capital intensive technologies financed and manufactured elsewhere. From the perspective of a global economy, the concept of local may include not just small fishing communities, but be extended to include more extensive regions such as the state of Tasmania, or states such as the nation of Australia. The prosperity of people in these regions may be enhanced by inefficient practices that dissipate resource wealth within the region rather than allowing it to be consolidated and exported. There will nevertheless always be individuals and occupations at each level of community, local, regional and state, who will gain advantage relative to others in their community, from participating in the consolidation and export of wealth through every step of the progression from local, to regional, to state and ultimately into the sink of the global economy. These individuals will promote an efficiency agenda that suits their interests.

In conclusion, managing fisheries by efficiency constraint can be an effective and environmentally responsive way to conserve fishery resources. It can also promote regional prosperity and progressive, wealth equalising distributional effects in fishing communities.

6. TASMANIA'S FISHERIES

6.1 INTRODUCTION

Fishing is important to Tasmania's economy. The abalone fishery, which in 1996/97 was worth in excess of \$63 million (Department of Primary Industry and Fisheries (DPIF), Tasmania 1997b: 1), is the most valuable of Tasmania's fisheries in terms of landed value of the catch. Tasmania's abalone fishery emerged in the 1960s with the advent of compressed air diving technology and lucrative Asian markets. Entry was limited in 1969, quota based management was introduced in 1985, quota holding was separated from the fishing entitlement in 1991, and formal property rights to quota were introduced with a "Deed of Agreement" in 1994 (DPIF 1997b: 73-75). The fishery generates a significant rent for quota holders. There has been a trend towards investor ownership of quota, which is harvested increasingly by contract divers (DPIF 1997b: 13). Of the total value of the catch, contract divers earn about 10 percent, the Tasmanian Government gains a royalty of about 10 percent, and most of the remainder goes as rent to the quota owners. The conversion of what may once have been a community resource to one that is effectively privately "owned" has seen the consolidation of considerable wealth into relatively few hands.

Tasmania's rock lobster fishery is second in total value and is the principal subject of this chapter. There is also a diversified scalefish fishery which has had few restrictions on entry in the past but is now being managed more intensively. The number of licences, the methods, and the amounts of gear that may be used are becoming more restricted.

6.2 THE ROCK LOBSTER FISHERY

6.2.1 INTRODUCTION

The southern rock lobster (*Jasus edwardsii*) has traditionally supported one of Tasmania's most important wild harvest fisheries. Annual catch from the commercial rock lobster fishery was worth approximately \$40 million in 1995 (DPIF 1997a: 13). The industry directly employs about 761 people in Tasmania (Williamson, Wood and Bradshaw, 1998: x) and contributes significant socio-economic benefits to many of Tasmania's coastal regions. Recreational fishing for rock lobster is also an important cultural tradition for many. Approximately 6153 recreational pot licences and 3465 recreational dive licences were issued for the 1996/97 season (DPIF 1997a: 24).

The Tasmania rock lobster fishery has survived numerous "crises" and been the subject of several inquiries relating to its management over the last century (Winstanley 1973: 2-

7). In 1883 a Royal Commission of Inquiry (Seal *et. al.* 1883) preceded the introduction of a number of regulations. Significant changes occurred in the management of the fishery with the introduction of the use of pots in the 1920s (Winstanley 1973: 3-5; Wilson 1987: 5) and the move to a limited entry fishery in the late 1960s and early 1970s (Winstanley 1973: 7). For several years leading up to 1997, concerns about the fishery and different views on the direction its future management should take were the cause of conflict and division within the industry. Three reports were published in 1997 advocating different prescriptions. Tasmania's Department of Primary Industry and Fisheries (DPIF), the agency responsible for managing the fishery, released for public comment, a draft management plan for the fishery (DPIF 1997a), the central feature of which was the proposal to introduce a management system for the fishery based on transferable quota. Industry was divided about this central issue of the draft plan. There was strong opposition to quota-based management from some sectors. In response to these concerns, Tasmania's Legislative Council conducted a Select Committee Inquiry into the Tasmanian Rock Lobster Fishery and published a report (Parliament of Tasmania 1997) that was critical of some aspects of the draft management plan. The Select Committee's report opposed the introduction of a quota management system (QMS) at this time and recommended a gradual rationalisation of the industry, prior to the eventual introduction of quota based management in the future. A third report which had some bearing on the matter was the Nixon Report (Nixon 1997). Commissioned to provide advice to government on matters of economic policy, it devoted some attention to fisheries management. It recommended removing many of the input controls that have historically been the foundation of conservation and management of the fishery in order to promote economic efficiency and profitability. It also recommended that the Government buy out existing "stakeholding" in the fishery and allocate the total allowable catch by tender.

The eventual outcome of management deliberations was a Management Plan for the fishery implemented in March 1998 (DPIF 1997c) and (*Fisheries (Rock Lobster) Rules 1997*), which essentially followed the intentions of the Draft Management Plan but included some concessions to the historically big catchers in the fleet by including an element of catch history in the initial allocation of quota (*Living Marine Resources Management Amendment (Rock Lobster Quota) Act 1997*).

Past and present management of Tasmania's rock lobster fishery contains elements that are illustrative of some of the issues of allocation and efficiency that relate to the concept of ecologically sustainable fisheries management. The fishery serves as a useful case study to consider the interests served by management trends, and provides an opportunity to speculate on the possible socio-economic outcomes that may have occurred if different management policies had been implemented.

6.2.2 HISTORY OF THE TASMANIAN ROCK LOBSTER FISHERY

Tasmania's Aboriginal inhabitants have fished for lobster for tens of thousands of years. The commercial fishery of today has its origins in the early years of European settlement when the industry was established using sail and oar powered vessels in the nineteenth century (Seal *et al.* 1883). Since that time, developments in the fishery have been characterised by continuing technological advances which have affected the harvesting, transport and marketing of rock lobster. Management policy over the years has also demonstrated a trend of progressively relieving efficiency constraints and increasing restrictions on access (Winstanley 1973: 2-7; Parliament of Tasmania 1997).

Early in the twentieth century, petrol auxiliary motors improved the efficiency of vessels and refrigerated cargo holds permitted year round access for Tasmanian lobsters to markets in Melbourne and Sydney (Smith and Fergusson 1969: 4). Following World War II there were many technological advances. Sail power virtually disappeared, replaced by diesel engines. Mechanical pot haulers, refrigeration units and pumps for circulating water in holding tanks were added to many vessels. By the mid 1950s echo sounders were in general use. Together with pot haulers they made it possible to locate and effectively fish the reefs in deeper waters and more easily locate and deploy pots over productive "hard-bottom" in shallow and inshore waters (Smith and Fergusson 1969: 5). On-board refrigeration increased fishing efficiency by allowing sufficient bait to be stored for extended trips, thus relieving fishers of the need to divert attention from lobster fishing in order to fish for bait. The introduction of synthetic ropes and buoys also increased fishing efficiency (Smith and Fergusson 1969: 5).

In recent years, satellite based navigation systems, generally known as global positioning systems or GPS, have had a tremendous impact on the rock lobster fishery (DPIF 1997a: 12). Almost every fishing boat is now equipped with GPS and they allow accurate navigation without the need for fixed, land based reference points. The use of GPS thus makes it possible to navigate with exceptional ease and accuracy and greatly facilitates fishing offshore reefs because search time needed to return to productive areas or to recover pots is greatly reduced. GPS also makes it easier for fishers to cheat on the efficiency constraint provided by the input control limiting the number of pots that may be used (DPIF 1997d: 17). With the aid of GPS it is easier and safer to illegally fish strings of extra pots because there is no need to mark their position with a surface buoy in order to recover them. Extra pots on longlines, fished out of sight of land, can be recovered using a grapple after navigating to the approximate locality using GPS. In the public consultation process relating to the draft management plan, over-potting was raised as a significant concern by many in the industry (DPIF 1997d).

Technology has also provided an expanding market for Tasmania's rock lobster which has resulted in significant price rises for the commodity (Parliament of Tasmania 1997: 55). The technology to ship frozen tails to overseas markets after World War II was partially responsible for the post war boom in the industry (Smith and Fergusson 1969: 4) and in recent years the greatly improved efficiency and reduced cost of air transport has facilitated development of the live export trade to interstate and overseas markets. The increased value of the catch has a similar effect to increased catching efficiency in supporting a trend toward biological overfishing in the equilibrium yield model.

6.2.3 REGULATION AND MANAGEMENT

The rock lobster fishery has been formally managed since at least the early 1880s when, following a Royal Commission of Inquiry, William Saville-Kent, the Superintendent and Inspector of Fisheries, introduced the first set of laws to regulate it (Parliament of Tasmania 1997: 34). Regulations included the establishment of a minimum size limit of 12 inches (Winstanley 1973: 3). This regulation, with slight variation over the years, has effectively been retained to the present day, and the current size limit is a carapace length of 110mm for male and 105mm for female lobster. This size limit has proven to be a very effective conservation measure, protecting the fishery from biological overfishing (Harrison 1987b: 11; Parliament of Tasmania 1997: 34). Seasonal closures have also been used to manage the fishery since the 1880s (Winstanley 1973: 3,6). The periods of closure have altered from time to time in the intervening years.

Regulations pertaining to efficiency and access have shown a directional trend over the past century. In 1883 Tasmanian fishers used hoops or rings to catch lobster (Seal *et al.* 1883: xii). Winstanley (1973: 3) notes that pots had been tried in the 1880s, but were not used by local fishers who considered them to be destructive and the cause of depletion of the beds. It is unclear whether pots were expressly prohibited at this time or their use discouraged by informal community sanctions, but their use by fishers from Victoria was a cause for some concern (Seal *et al.* 1883: xv) because it was believed that lost pots would continue to trap lobsters or "ghost fish" (Storey 1998). Seal *et al.* (1883: 5) recommended that the potential to increase catches by the use of pots be investigated. In 1902 the use of pots in Tasmanian waters was expressly prohibited (Winstanley 1973: 3). Fishers from Victoria continued to fish with pots and defy the regulations, and extended their activities down the east coast as northern waters were depleted (Winstanley 1973: 3). The authorities appear to have had little success in preventing them. In 1905 regulated use of pots was permitted down to 40°38' south. In 1913 this was extended to 42°21' south and in 1925 pot use was extended to all Tasmanian waters with the exception of the Derwent Estuary, the D'Entrecasteaux Channel and Storm Bay (Winstanley 1973: 3-5).

During the early 1920s the introduction of pots had been strongly opposed by many fishers who believed that their use would deplete local fishing grounds and jeopardise their means of livelihood (Winstanley 1973: 5; Wilson 1988: 5). The regulations in 1925 regulated the use of pots according to vessel size, with larger vessels permitted to use more pots (Winstanley 1973: 6). Many of the artisanal fishers accustomed to using rings from small vessels close to shore would have been disadvantaged. They may not have had access to the necessary capital to obtain a vessel suited to the pot fishery and their viability would likely have been affected by competition from the more efficient technology on the fishing grounds and the depletion of the beds. The use of pots across the fleet increased fairly slowly from 15 percent of vessels in 1925 to 37 percent in 1939, due to the restricted size of some vessels, the cost of the pot licence fee, and the preference of many fishers for the traditional method (Winstanley 1973: 10).

In 1925 the maximum number of pots permitted for use by the largest vessels in the fleet was 30 (Winstanley 1973: 6). This was increased to 40 in 1960 (Winstanley 1973: 7) and 50 in 1998 (DPIF 1997a: 44). The Select Committee Report recommended it be raised to 60 (Parliament of Tasmania 1997: 10) and the Nixon report recommended removing the limit altogether (Nixon 1997: 186). Over this time the scale was adjusted several times, allowing increasing numbers of pots to be used by smaller vessels in the fleet as well.

Prior to the 1960s access to the fishery was really only limited by the requirement for sufficient capital to provide a vessel of adequate size to qualify for the use of pots. The move to a limited entry fishery occurred in the late 1960s and early 1970s when the number of licences and the total number of pots in use by the fleet were capped in order to control the growth in effort and maintain profitability for operators (Winstanley 1973: 7; Parliament of Tasmania 1997: 19). The number of licences was initially capped at 420. This number was gradually reduced in the following years as some operators retired and pots were amalgamated into fewer though larger holdings. Limiting entry had a significant effect on the ongoing development of the industry. It was the first major step toward enclosure of the resource and the establishment of a property rights based fishery. Within a few years the limited number of rock lobster fishing licences and pot entitlements were allowed to be transferred and thus became tradable property. Limiting entry did not however prevent the growth of effort in the industry. Licence holders invested in bigger boats and better equipment (DPIF 1997a: 77), and the increasing price of lobster encouraged fishers to work longer and harder than before as they competed with each other for larger shares of the resource to which they jointly enjoyed privileged access.

6.2.4 CATCH STATISTICS

In spite of the significant growth of fishing effort over the past century, the available catch statistics demonstrate a remarkable consistency in the annual production from the fishery. Winstanley (1973: 16) noted stability as a characteristic of the rock lobster fishery in spite of a tremendous increase in fishing effort. In 1930, after the introduction of pots in the industry, the average catch for the fleet of nearly 50 vessels in the industry was 48 000 pounds (Smith and Fergusson 1969: 4) which equates to a total catch of about 1090 metric tonnes. In 1938/39 87 vessels captured approximately 1590 metric tonnes (Smith and Fergusson 1969: 4). Catch data from the years between 1948/49 and 1963/64 show that the catch varied between a low of 993 tonnes (1951/52) and a high of 1 805 tonnes (1960/61) with no readily discernible trend (Smith and Fergusson 1969: 53). A similar pattern of fluctuation in the total annual catch within a fairly stable range of 1442 tonnes (1994/95) and 2288 tonnes (1984/85) is also reflected in catch data for the seasons between 1979/80 and 1995/96 (DPIF 1997a: 20).

While the significantly increased effort in past decades has not corresponded with an increase in the total annual catch, nor has there been a biological collapse of the fishery. This suggests that the rock lobster population is ecologically resilient to the sorts of pressures produced by fishing. Harrison (1987: 11) stated that: "So far as conserving the stock is concerned fishing effort need not be controlled". Conservation of the breeding stock was provided by the minimum size limit. Recruitment was not affected by fishing effort. In a fishery where there is little risk of biological stock collapse due to recruitment failure as a result of fishing impacts, management does not need to be overly preoccupied with the issue of biological sustainability in the sense of preventing extinction, and can focus on socio-economic questions of allocation and efficiency. However, concern over ensuring that recruitment is not jeopardised provides management with a powerful source of legitimacy to control access and allocation of stocks. The rhetoric of conservation is often used to justify measures, the effects of which serve primarily to allocate resources to, and further the interests of, particular stakeholders.

In contradiction to the long held belief that fishing effort need not be controlled in order to maintain adequate spawning and recruitment, was the concern expressed in the Draft Management Plan (DPIF 1997a: 25) that due to the fishing down of adult biomass, egg production particularly in the north of Tasmania, may no longer be adequate. Stock rebuilding was recommended. It could be argued that the establishment of marine reserves would be a more effective way to protect biomass for egg-production in Tasmania's north, than the introduction of a state-wide quota. However, stock rebuilding across the entire fishery is a prime economic objective of the management

plan, as it is the key to raising catch per effort and thereby reducing fishing costs and increasing rent production or profit from the fishery.

6.2.5 ROCK LOBSTER BIOLOGY

In the Tasmanian lobster fishery, the size limit protects most female lobsters from legal harvest until they have matured and spawned at least once. The size limit provides effective protection for lobsters in the south of Tasmania where, due to the cooler water temperatures, growth is slower and many fish mature, reproduce and may live out their natural life span without growing to the legal minimum size (Winstanley 1973: 22). In the south of Tasmania the size limit may be too high and limiting productivity from the fishery. In the north of Tasmania, where lobsters grow faster, the size limit may not be providing adequate protection. There is thus a recognised problem with the application of a uniform size limit in Tasmanian waters and managing the entire state as one fishery (DPIF 1997a: 36).

Female lobsters produce 22 000 to 500 000 eggs depending on their size (Winstanley 1973: 19) which, after hatching, undergo a planktonic larval stage in their life-cycle during which they are carried offshore by ocean currents. The larvae may spend one to two years in this planktonic phase and undergo several moults, finally developing a recognisable lobster form at a length of about 25mm. At this stage the juvenile lobster, referred to as *Puerulis*, swim or are carried by wind and ocean currents toward the shore and settle where they find suitable substrate. Over the next few years they grow and the females achieve sexual maturity at 4 to 5 years (Winstanley 1973: 19). Lobster recruit to the fishery (achieve the legal size limit) after about 6 to 8 years (Winstanley 1973: 19) though this is variable and appears to depend on factors such as water temperature and food supply.

Detailed knowledge of the population dynamics of the southern rock lobster in Tasmanian waters is quite limited and a great deal more research is needed to obtain a better understanding of many of the factors that effect lobster population ecology. However, experience suggests that as long as an adequate breeding population is maintained, the actual abundance of lobsters has little direct correlation with future recruitment to the fishery. It appears that recruitment is influenced by environmental factors.

Consideration of past catch and effort statistics does demonstrate that the fishery has a very flat yield curve under the current management system where spawning and recruitment are maintained and the stock adequately protected by the minimum size limit (figure 6.1).

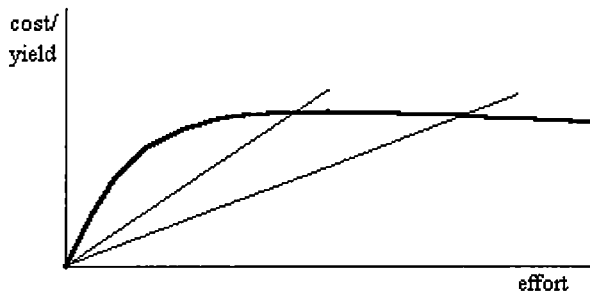


Figure 6.1 Sustainable yield curve for Tasmania's rock lobster fishery.

In theory, with a flat yield curve like this, significantly different levels of effort do not greatly effect the sustainable yield. Increasing fishing effort will not increase the sustainable yield nor will it greatly reduce it (assuming an appropriate size limit provides for adequate egg production and recruitment). In reality there would likely be some effect due to undersized fish being more frequently trapped and killed by octopus in pots, or exposed to damage from handling during release from pots, or to growth overfishing depending on growth and survival rates. The catch per unit effort will however be reduced as a consequence of increasing effort. This affects the economics and profitability of the fishery.

The catch per unit effort relates to the abundance of fish that are over the minimum size limit. Under heavy fishing pressure the abundance of "size" fish will be reduced as this part of the population is fished down and fish are caught soon after recruiting to the fishery, instead of having several years worth of recruits forming a larger residual population (DPIF 1997a).

If management were to significantly reduce fishing effort, the sustainable yield could still be maintained at a comparable level. The catch per unit effort would be increased because of the increased abundance of "size" fish in the population. This could have environmental benefits as the population might have a more natural structure without the distortion that heavier fishing pressure could produce by reducing the relative abundance of fish above the size limit. Other environmental benefits might also occur due to a reduction in the secondary impacts of fishing pressure. Less bait would be needed, less fuel used and there would be less disturbance to marine habitats and less disturbance of undersize lobster.

There are a number of ways that effort could be reduced. Efficiency could be constrained by input controls, the economic incentive to fish could be reduced by a

royalty attached to the amount of fish taken, or a total allowable catch could be introduced and allocated in some way so as to preclude competitive racing and all fishing effort curtailed once it had been reached.

Management prescriptions for the industry contained in the Draft Management Plan and the Nixon Report are based on an assumption of an allocated total allowable catch (TAC). The Select Committee recommended reducing efficiency constraints prior to an eventual adoption of a TAC (Parliament of Tasmania 1997: 10). The option of imposing additional efficiency constraint was not promoted. Only those options favouring "efficiency" in the production of profit or revenue from the fishery were put forward.

6.2.6 STRUCTURE OF THE COMMERCIAL ROCK LOBSTER INDUSTRY

Prior to introduction of the quota management system in March 1998 there were 321 vessels in Tasmania's commercial rock lobster fleet, ranging in length from 6 metres to 26 metres. The number of pots each vessel could use varied between a minimum of 15 and a maximum of 40, depending on the size of the vessel and the number of pots attached to the licence. There was a total of 10 507 pots in the fleet (DPIF 1997a: 12). Pots and licences were transferable and could be bought, sold or leased. The market value of licences has related almost entirely to the number of pots attached and it is the pots that have really represented the tradable "property" in the industry. In recent years the number of licences has declined as pot holdings were consolidated onto fewer licences. This trend led to a gradual increase in the average number of pots per vessel across the fleet. The market value of a pot was about \$4000 in 1987 (Campbell 1988: 30), \$6000 in 1991 (Morrow 1991: 12) and in March 1998 was reported to have reached \$13 500 (Williamson, Wood and Bradshaw 1998: 34). This made the capital value of a 40 pot licence more than \$500 000 in 1997/1998. Williamson, Wood and Bradshaw (1998: 54) estimated the total market value of licences in the industry at \$142 million in 1998, up from \$50 million three years previously.

Most licences have been owned in Tasmania and many licence holders have run owner operated family businesses. About 16 percent of licences were owned interstate and about a third of all licences were leased (DPIF 1997a: 13). In recent years there has been a trend toward investor ownership of licences (Williamson, Wood and Bradshaw 1998: x). Leasing arrangements have varied, but a typical seasonal lease for a 40 pot licence would have cost about \$50 000 in 1996/97. Approximately one third of the fleet had 40 pot licences and the rest were distributed between 15 and 39 pots (DPIF 1997a:15).

There has been considerable diversity in the fleet's operations. The west coast of Tasmania has generally been fished by larger vessels able to cope with rough conditions and capable of extended trips lasting several weeks (DPIF 1997a: 36). These vessels have needed to make large catches to cover their high capital costs, and catch rates on the west coast are usually higher than on the more heavily fished north and east coasts where stocks have been depleted. The calmer conditions of the east coast are more favourable for the smaller vessels in the fleet, many of which operate on a daily basis from port. Catches across the fleet have also been affected by a number of other factors, including the skill and experience of skipper and crew and personal choices about how hard they wished to work, the level of risk they were prepared to take to fish in adverse conditions, and lifestyle and income aspirations.

6.2.7 ECONOMIC CONSIDERATIONS

Adam Smith (1776: 203) observed in relation to fishing as a profession that:

They are all very poor people that follow as a trade what other people pursue as a pastime. Fishermen have been so since the time of Theocritus. The natural taste for those employments makes more people follow them than can live comfortably by them.

In other words, people are prepared to accept lower monetary rewards from a fishing career than they might earn in other occupations. They accept a lower return than their opportunity cost of labour because they are being subsidised by the pleasure and satisfaction, the non material well-being benefits, that they obtain additional to their financial earnings. Where fishermen invest in equipment or entitlements to fish, they might seem to be prepared to accept a lower return on their investment than would appear to be reasonable according to market rates of interest. Their capital could earn more interest elsewhere. The opportunity cost of capital might not be met in financial terms because of the life-style benefits or satisfaction subsidy that fishers obtain in addition to financial returns. Rock lobster fishing in Tasmania is a recreational activity for thousands, and commercial fishers obviously obtain satisfaction and well-being benefits from their profession in addition to financial rewards. Economic assessment of the industry might therefore be expected to demonstrate poor or marginal performance if well-being benefits are not measured.

The economic "viability" of the fleet has frequently been a cause of management concern. In the mid 1960s, prior to the introduction of limited entry, Smith and Fergusson (1969: 45-47) found that the fishery was "marginal"; producing only a small economic surplus. This surplus, due to technological efficiency gains and the increased market value of lobster, would be eroded in the long run as more effort would be attracted into the fishery until the equilibrium point was reached. The move to limited

entry and a gradual reduction in the number of licences did not curb the growth of effort. Approximately the same number of pots remained in the fleet and they were worked longer and harder from increasingly larger, more capable and more costly vessels.

In 1987 Campbell (1988: 29) suggested that the best indicator of the economic performance of the industry was whether there was an incentive to enter. At this time Campbell (1988: 33) found that the market value of licences, at \$4000 per pot, was justified by the economics of the industry, that is, new entrants paying this price of entry would be economically marginal. For their operations to become profitable, the profitability of the fleet would need to increase. This would also result in the cost of licences increasing for new entrants and would result in capital gain to those already established. Rent from the fishery and the capital value of licences was due to the surplus produced because the fishery was not at equilibrium. This situation had been maintained by efficiency creep brought about by technological innovations over preceding years and by a rising market price for lobster. Given time one would expect this surplus to be eroded by increased effort and stock depletion until equilibrium was established. This would eventually reduce the capital value of licences to zero at the equilibrium point. Maintenance of the capital value of licences depends largely on maintaining the level of catch per unit effort and this requires that effort be constrained below the equilibrium level. For the fishery to be profitable the economic return has to exceed costs including the rent on licence value. This is difficult to maintain in the long run as the licence value immediately appreciates to absorb any increase in profitability. Sustaining the production of rent requires that total effort be constrained, whilst producing profit over and above rent requires continual efficiency creep and/or a continual increase in the price of the product. Obviously it is not possible to continue to reduce the cost of harvesting lobster indefinitely. There are constraints on efficiency which is affected by the law of diminishing returns. The price is set by the global market and is outside management control. It is clear then, that profitability in the fishery over and above the production of rent cannot be maintained indefinitely, and it may be misleading to judge the economic performance of the industry on the basis of measures of profitability.

In 1991 Morrow (1991) completed an economic analysis of the industry based on calculations of the internal rate of return, a measure of the performance of investment capital. Morrow found the industry a marginal prospect for investment. This is not surprising since surplus or rent produced would be reflected in the capital value of pots that investors would have to pay to get into the industry. As long as pots have a positive value we can assume that the fishery is producing resource rent or economic surplus. As in every business, some individual operators may be more or less successful than others. If profitability of fishing operations increases due to improved fishing technology or a

significant increase in the market value of the catch then we would expect the value of pots to appreciate to accommodate this gain. An economic assessment that includes the capital value of pots as a cost or opportunity cost would not be expected to demonstrate a profitable industry. If it did so, it would indicate a failure by licence holders to appreciate the value of their assets when they leased or sold them. Nor would one expect an analysis that did not measure non-financial well-being returns, the satisfaction subsidy that nevertheless affects the market value of pots, to find the industry performed well in terms of return on financial investment.

In 1991 Morrow found that, with the market price of pots at \$6000, the industry was not an attractive opportunity for investment according to an economic analysis based on the internal rate of return. By 1997 the market value of pots had risen to about \$12000, largely due to an increase in the market price of lobster from about \$17 per kilogram in 1991 (Morrow 1991: 5) to approximately \$28 per kilogram in 1997 (DPIF 1997a: 18). However, if an economic analysis based on internal rate of return were applied to the fleet today, it is likely to reach a similar finding to Morrow's in 1991. The fleet would be found to be economically marginal because the increased economic surplus from the fishery is countered by the increased capital cost of licences, the value of pots reflecting the resource rent being produced.

Morrow (1991: 16) pointed out that Tasmania could choose to have a large and inefficient fleet or a smaller efficient one. He suggested that the fishery and coastal communities associated with it would continue on a course of gradual decline unless management action was taken to rationalise the industry in order to make it more efficient by reducing operational costs:

To survive in the longer term the fleet must be efficient and be allowed to harvest the available stocks at the lowest possible cost.

and:

If input controls continue to be the basis of the management then the socio-economic structure of the fishing villages around Tasmania is unlikely to change rapidly but gradually slip backwards as the economic climate of the fishery declines.

To increase industry efficiency, Morrow (1991: 16) advocated replacing efficiency-limiting input controls with output controls such as a quota based management system. However it may be that the principal economic benefits of the industry to coastal communities are more closely associated with the operational costs of the fishery, such as wages and supplies, than with the surplus revenue it generates. The decline in these regional economies may have more to do with reduced employment due to gains in

efficiency in previous years and a reduction in the size of the fleet. Further gains in fishing efficiency, far from reversing this trend, might be expected to exacerbate it.

6.2.8 MANAGEMENT PROPOSALS

6.2.8.1 The Draft Management Plan

The management proposals put forward by the Tasmanian Government in the Draft Management Plan (DPIF 1997a) were for the introduction of a quota management system (QMS) for the fishery to limit effort and allow a relaxation of some input controls to increase efficiency. The decision to adopt a QMS was supported by a ballot of licence holders in 1995, in which 53 percent of primary votes favoured quota (DPIF 1997a: 21). Only licence holders, the owners of property rights relating directly to the resource, were included as "stakeholders" in the ballot. Other fishers, skippers, deck hands and licence leasees were not consulted. Quota management represented a significant change from the established limited entry, input controlled regulations that were failing to contain the expansion of effort. A total allowable catch (TAC) for the fishery would be set, based on annual assessment of the stock, and this TAC would be allocated on an equal per pot basis among the licence holders.

For the first years of the management plan a TAC of about 1500 tons was proposed (DPIF 1997a: 41). This, divided by the 10 507 pots in the industry, amounted to a quota allocation of 143 kg per pot. The TAC was determined on the basis of a stock assessment involving independent sampling and analysis of industry catch returns. It reflected the management goal of reducing the annual catch to below the levels of recent years in order to allow stocks to rebuild, which in itself should improve the future catch per unit effort in the fishery, reducing overall fishing costs and increasing profitability. This would also perhaps improve the population structure of the stock with benefits to biological sustainability and recruitment (DPIF 1997a: 27-30).

The preference for per pot allocation acknowledged pots as the traditional unit of tradable property in the fishery, and the basis of past investment and current 'stakeholding' in the industry. Quota would be tradable and the number of pots allowed per vessel would increase by 25 percent to allow for amalgamation of holdings and restructuring of the industry toward fewer, more efficient vessels. The maximum number of pots that could be fished from the larger vessels would increase from 40 to 50 (DPIF 1997a: 44). These additional pots would have to be bought from other licence holders out of the limited number of 10 507 pots in the fleet.

It was recognised that there would be winners and losers from the implementation of this management plan. There would be an apparent gain to about two thirds of licence

holders, those who had been catching less than 143kg per pot (Parliament of Tasmania 1997: 69-70). They would be able to sell the proportion of their quota that they did not catch themselves. Licence holders generally should gain financially due to a likely increase in the capital value of entitlements in response to a greater definition of the property rights assigned to each pot by the quota system, and the likelihood of increased rents accruing to that property as a result of efficiency gains due to the relaxing of some input controls and anticipated stock rebuilding.

The move to limited entry to the fishery in the late 1960's established *de facto* "property rights" in the fishery and paved the way toward enclosure of the resource. Licence holders shared the privilege of commercial access to the fishery. However there was still the problem of competition between licence holders for a larger share of the common resource. The nature of property rights based on a right to fish does not lend itself to quantification. The value of the right to fish, in terms of the rent it generates, depends to some extent on the skill of the fisher. A skilled and experienced skipper would therefore be in a position to capture some of the resource rent and thus share it with a non-fishing licence owner; one would expect the market price of leasing a licence to reflect the surplus that the least efficient skipper in the fleet was able to pay. The move to a quota based management system would define those property rights in a manner more suited to the interests of an investor. One would expect the market price of buying quota to reflect its value to the most efficient operator in the fleet. Rights that are quantifiable, in this case based on the weight of lobster that may be caught, can be more easily managed, counted and traded. The quota management system itself, through the compliance reporting requirements, puts in place a system of accounting which maintains and adds to the value of the property rights associated with fishing entitlements by enhancing their definition and making them a more market-friendly commodity. It also provides a mechanism that aids enforcement. Under the quota system, licence holders effectively become share holders in a monopoly.

Other potential winners who might be expected to benefit from the move to a quota management system include agencies with a role in research, management and policing of the fishery who would gain increased funding to allow them to manage the increased complexity of a quota management system. The Draft Management Plan indicates an increase in the budget for these management functions (DPIF 1997a: 73).

Small owner-operator fishers were seen as likely to benefit from the QMS as they would receive a quota allocation proportional to their pot holdings, which in many cases exceeded their past levels of catch (Parliament of Tasmania 1997: 69). They would also be likely to benefit from reduced competition on the fishing grounds and increased catch rates if stocks are rebuilt. They would however have to contend with the onerous

reporting procedures associated with administration of the QMS. This might be expected to impact on enjoyment and reduce the vocational satisfaction of fishing as a profession. Those fishers who are also licence holders may find that the costs on one hand are compensated by the gains on the other.

Losers from the proposed management changes are those fishers who have leased licences and those who have worked as skippers. They were not considered as "stakeholders" in the decision making process and did not have a vote on the issue of adopting a QMS. They would be subject to more onerous accounting procedures and reduced opportunities to gain a share of the resource rent. With stock rebuilding and improved catch rates there is likely to be a shift toward contract harvesting of investor controlled quota. There will be less demand for the specialised skills and knowledge of experienced fishers (Williamson, Wood and Bradshaw 1998: 118).

Future generations of fishers and 'would be' fishers would also be losers from the move to quota as the allocation of quota represents a one-off transfer of the wealth of the fishery into the hands of existing licence holders. Future entrants will have to buy into the industry (Campbell and Haynes 1990: 2) and the cost is likely to increase and continue to be prohibitive (Williamson, Wood and Bradshaw 1998: 134). Much of this transfer occurred 30 years ago with the move to limited entry, but the move to greater definition of property rights under a quota system is likely to raise the cost of entry. Other losers are those fishers or deck-hands squeezed out of employment by the anticipated restructuring of the fleet for improved efficiency. The gains in efficiency would largely be achieved by reducing the costs associated with paying wages and the anticipated reduction in total effort would reduce the amount of labour employed in the fishery by up to half (Williamson, Wood and Bradshaw 1998: xii). The communities where redundant fishers might otherwise have lived and spent their wages would also lose economically from the restructure of the industry for greater efficiency.

Because they were acknowledged "stakeholders", the group of losers from the proposed changes of most concern in the decision making process were the traditionally "big catchers" in the fleet. These were the licence holders, about a third of the fleet, who had been catching in excess of 143kg per pot. They would have to buy up extra quota to maintain their catch levels and their accustomed incomes. It was primarily the interests of this group that were championed by the recommendations in the Select Committee Report.

6.2.8.2 The Select Committee Report

The Select Committee found that the fishery was not in danger of imminent collapse but that a reduction in effort and catch was necessary to avoid a gradual decline (Parliament

of Tasmania 1997: 6). The report contained a detailed history of the development and management of the fishery. Efficiency gains as a result of technological improvements over past decades were clearly identified as the major causes leading to overfishing and overcapacity (Parliament of Tasmania 1997: 47-57). The link between the progressive increase in the market price of lobster over past decades, and overfishing, was also made. But the recommendations contained nothing to address these causes of the problem. On the contrary, the report recommended further reduction in efficiency constraints by raising the maximum number of pots that can be used on a vessel from 40 to 60 (Parliament of Tasmania 1997: 10).

The report was opposed to the introduction of a quota management system until the industry had been restructured. By first reducing the number of vessels and people employed in the fishery, when a quota system was eventually introduced, individual allocations would be larger as there would be fewer to share the total allowable catch (Parliament of Tasmania 1997: 10). The report also suggested that allocation of quota should recognise catch history. Those operators with a history of larger catches, should it argued, be allocated proportionately more quota (Parliament of Tasmania 1997: 78). This method of allocation, while clearly in the interests of the big catchers in the fishery, challenged the established position of the pot as the unit of "property" in the fishery. This emphasised the difficulty of finding a mechanism to equitably translate the pot entitlement into a unit weight allocation of lobster under a quota management system. Many of the big catchers had more capital intensive operations that fished off the west coast and wide offshore for large quantities of lower value product from deeper waters. They operated with high overheads and small margins and needed to catch larger quantities of lobster than many east coast fishers in order to remain viable and their concerns with per pot allocation were understandable.

6.2.8.3 The Nixon Report

The Nixon Report assumed the introduction of a quota management system for the fishery in accord with the government's intentions as outlined in the Draft Management Plan. However it recommended that existing investment in pots be bought out, paid for by allocation of quota by tender, and that in the interests of efficiency, the remaining input controls regulating the fishery be abolished (Nixon 1997: 186). If this plan were implemented there would probably be some capital gain for government which would capture the one off gain in value caused by removing efficiency constraints.

6.2.8.4 Discussion

In terms of their vision for the future of the industry, these three prescriptions for management differed little from each other. They all shared the management goal of increasing efficiency, viewed as the production of profit, rent or surplus revenue, and of

achieving this goal primarily by reducing the number of vessels and people employed in the industry. If the biomass of "size" fish is rebuilt, the catch per unit effort should increase, and less effort would be required to harvest the total allowable catch. Less effort translates into less employment in the fishery. The reduction of some input controls, notably the limit on the maximum number of pots per vessel, would also result in less employment of labour in the fishery.

Where the three prescriptions differed is in their advocacy for the interests of particular groups of stakeholders. The Nixon Report's recommendations might capture a capital gain for government. The Draft Management Plan advocated quota allocation on a per pot basis whereas the Select Committee Report suggested that quota allocation, if and when introduced, should be based on catch history to more fairly represent past patterns of access and usage of the resource. Here the argument was primarily about how the cake should be divided among licence holders. There are valid arguments in favour of each approach, but in the long run, all licence holders stand to benefit financially to some extent by the introduction of quota, as efficiency gains should see more resource rent generated from the fishery, thus raising the capital value of the property rights attached to their licences. Admittedly in some cases where licence holders are also fishers, representing both capital and labour, this gain in property value and rent may be offset to some extent by reduced earnings as fishers.

The benefit to licence holders comes at the cost to society of reduced opportunities of access to the resource through employment opportunities due to the high cost of entry caused by sustaining the capital value of licences, and of reduced distribution of the economic benefits from the fishery as its wealth is further consolidated in fewer hands. The Tasmanian Government frequently proclaims job creation is a high priority yet all management proposals will reduce direct employment in the fishery and there is no reason to believe that revenue gains will generate additional jobs in Tasmania. The productivity of the industry is limited by the biological constraints of rock lobster ecology. The total value of the fishery has progressively increased in recent decades as the market price for lobster has risen. The industry today could sustainably generate a higher income, adjusted for inflation, than it has in recent years. This income could support more people in employment than the industry employed in the past. Morrow's report (1991:16) presented the options of a large fleet of inefficient vessels or a small fleet of efficient vessels. The Select Committee Report also acknowledges that there are options. Tasmania could have a large fleet maximising employment and lifestyle opportunities, each limited to a low annual catch, or a more "efficient" smaller fleet (Parliament of Tasmania 1997: 20) producing more economic surplus. However all proposals favour managing the fishery to reduce employment and increase production of revenue.

It is quite likely that the economic prosperity and the social well-being of Tasmanian society is compromised by the way the rock lobster resource is managed to favour capital interests and revenue production. It is possible that a different approach, one that stressed equal opportunity of access and conservation through efficiency constraint, could produce more favourable economic and social well-being outcomes for Tasmania if vested interests had not become established and gained so much influence in the decision making process.

Vested interest politics and historical precedent significantly affect how resources are used and opportunities of access are distributed in society. Established practices of resource distribution and use leave a legacy that persists in society, in the culture of its institutions, and in the cultural traditions and expectations of its people (Putnam 1993: 123-157, Leftwich 1983: 219-261). These practices are maintained by patterns of wealth and power distribution and resource managers are bound to a large extent by them, a process Randall (1981: 150-151) refers to as *conservative reinforcement*. However it is interesting to venture into academic speculation on possible social and economic outcomes of different practices of distribution of access to resources. And if these possibilities promise better outcomes than the continuation of past and present trends then they may offer something to work towards against the inertia and within the constraints imposed by whatever interests hold power at any given time.

6.2.9 HYPOTHETICAL - AN EQUAL ACCESS FISHERY

Suppose Tasmania's lobster fishery were to be managed according to the principle of "equal access" and overfishing prevented by the use of efficiency constraints. This would imply the elimination of private property rights in the fishery, presently maintained through limited entry and transferability of individual entitlements, and re-establishment of the fishery as a commons.

Tasmania's rock lobster fishery is managed as a single unit with uniform regulations applying across the state. This is a consequence of the administrative circumstances; of a central management authority being vested in the hands of state government. Management based on the assumption of a single fishery is not compatible with the biological characteristics of rock lobster populations in Tasmania, with the geography of the fishery in terms of the diversity of the physical characteristics of the fishing grounds around the state (DPIF 1997a: 36), and it does not allow for much diversity in management of the resource to meet the specific needs of individual coastal communities for commodity and other economic and social values.

The inadequacy of whole of state management is recognised in relation to the uniform size limit which is thought to provide inadequate protection for stocks in the north and imposes an excessive constraint on productivity in the south. The possibility of zoning the state into 2 or more management units is acknowledged as an issue for future consideration (DPIF 1997a: 36), but the difficulties of introducing such a plan into the property rights based structure of the industry would be considerable.

Let us nevertheless assume the identification of numerous regional management units, each regulated according to the locally specific circumstances of lobster stocks, the local community, and physical geography. The state would still be the principal management authority but regulations for each region would be made in consultation with the local community, local government and local fishermen. For the sake of the exercise the principle of "equal access" would apply in recognition of its value in providing the necessary pressures and incentives to justify and maintain efficiency constraint as the regulatory means of preventing overfishing, and to prevent the establishment of exclusivity and privilege which would undermine equality and community ownership. "Outsiders" could fish in any waters subject to the particular rules for that management unit, and if a community did not want fishers from somewhere down the coast to come and clean out their fishing grounds with a 40 pot vessel, they could make rules to prevent use of this gear in their waters. If they prohibited the use of pots entirely, or limited use to 5 or 15 pots per vessel (for example), or used other controls deemed appropriate, it might not be worthwhile for outsiders to come and fish those waters, while locals with less distance to travel and the opportunity to develop knowledge of the local grounds would have the advantage. While they would be restricted in the amount of gear they could use, their operations would still be viable at some level.

Hoefnagel (1996: 69) points out the danger of shifting effort to inshore waters that can accompany downscaling of fleet vessel size, but this could be managed by segregating the fleet by zone-focused management. In some waters, offshore on the west coast for example, it may be appropriate for fishers to be allowed to use 40 pots or more from large vessels. In other areas conservation needs and the appropriate level of efficiency constraint may require that vessels be limited to 15 pots, or 2, or to the use of rings only, as was the rule before pots were permitted in the fishery. In some places no motor rules might be appropriate. The possibilities are endless but appropriate regulations for each unit could be developed to suit the management goals of each fishery. An east coast community, for example, might find it could obtain the greatest value from its local lobster resource by using it to attract recreational fishers and holiday makers to the region.

There are all sorts of measures that could be taken to manage the local resource to best meet social and economic goals. These measures might differ significantly from the established centralised approach, but they would be technically possible. There are many examples worldwide of a regional focus in management approaches, including the Falmouth oyster fishery, Buen Hombre and Norway's coastal fjords. In South America many countries reserve coastal waters out to 3 nautical miles for artisanal fishing and restrict industrial fishing to offshore waters. A similar approach might be useful in Tasmania's rock lobster fishery, limiting industrial pot fishing to the west coast and offshore waters and developing artisanal fisheries in other places to generate maximum employment and value maximisation of the resource to the local community. While some would argue that much of Tasmania's rock lobster fleet does have characteristics of an artisanal fishery, the prohibitive capital cost of entry precludes this classification. Efficiency would need to be constrained sufficiently to reduce the financial barrier of entry to the fishery. This could be achieved in various ways; by gear restrictions, application of daily bag limits, or an efficiency constraining royalty levied on the catch. There is no reason why a quota system could not also be used in some regions of Tasmania, such as offshore waters. There would be difficulties with implementing complex rules but so there are with implementing the current quota system where each lobster must be accounted for. Indeed there is a precedent for regional or zone-based management with the D'Entrecasteaux Channel effectively reserved for recreational lobster fishing by diving or by the use of rings and pots not permitted (DPIF 1997: 59). Difficulties, then, could be overcome.

There are ways that some revenue or economic rent could be obtained from the resource for the state or community without undermining "equal-access". A royalty could be applied - all lobster taken, sold, or exported could be required to be tagged with an individually numbered \$5 tag, for example. Arnason (1993) points out that a tax on catch is likely to be an effective control on effort.

There would be greater opportunities for value adding beyond the commodity perspective. While the highest commodity market price for lobster, possibly \$50 per kg, might be achieved by flying it live to Singapore or Hong Kong, far greater economic benefit to some coastal communities might be obtained if sale and direct commodification of the resource were discouraged. Instead wealthy lobster lovers might be encouraged to visit Tasmania and spend hundreds of dollars on high local content services, stay in local bed and breakfast accommodation, and pay to go on a tour, perhaps a lobster ring or pot lifting fishing trip to a well stocked reef conserved by excluding commodity-centred rather than experience-centred commercial fishing activities. They could have their catch cooked for dinner, and it is possible that in obtaining a \$50 lobster for "free" they would contribute hundreds of dollars into the

economy of the local community. This approach has a precedent in Tasmania's inland trout fishery, which yields significant economic benefits to the community as a recreational resource that attracts tourists to the state. Commercial harvesting is not permitted, and if it were, it would result in value reduction down to the commodity value of the resource.

There would likely still be a place for commodity marketing of an appropriate portion of the state's lobster resource, but priority could be given to prosperity-maximising options for the community. The total value of the resource to the Tasmanian community could be greatly increased by a management strategy that allowed greater diversity and flexibility in pursuit of maximum value. While a management strategy would benefit from a regional focus to provide optimum management according to local circumstances and provide for local conservation and socio-economic requirements, there would still be an important role for a central management agency. It could provide a body to coordinate research around the state and provide a "higher" authority for prosecution of offenses, though much of the policing of local regulations might be effectively carried out at the local level, either informally by community members with a stake in the resource, or more formally by locally employed bailiffs or wardens as in the Falmouth oyster fishery and the Buen Hombre fishery. The central authority could also be an important source of power for maintaining equality of access by preventing the locally powerful from assuming control.

6.2.10 COMPARISON WITH THE CRITERIA FOR ECOLOGICAL SUSTAINABILITY

How would management of Tasmania's rock lobster fishery, either by property rights and enclosure for increased economic efficiency, profit and rent, or according to the principle of equal access and conservation through economic inefficiency, compare against the criteria that contribute to and define ecologically sustainable development of fisheries?

Managing for increased efficiency will lead to a significant reduction in employment in the fishery. As a policy it does not measure well against the statement for ESD fisheries (Commonwealth of Australia 1991: 9), that: "The thrust of economic policy should be directed at achieving social justice objectives, in particular, full and meaningful employment." The nature of employment in the industry may also change with less opportunity for independent fishers to pursue a lifestyle choice and exercise the skill, knowledge, craft and hunting instincts of the traditional owner-operator, to employment of a more industrial nature that may provide little satisfaction apart from wages (Williamson, Wood and Bradshaw 1998: 119-120). It may be far less satisfying than the alternative of employment, on either a full time or a part time or seasonal basis, in an

artisanal, equal access, efficiency-constrained fishery that affords the individual opportunities for independence.

The ESD value of intragenerational equity - if the definition of equity is taken to include equality of opportunity - is clearly compromised by management for efficiency by enclosure and a property rights-based access to the fishery. The consequences of this to other values of ESD have been discussed. The spillover effects of enclosure of one resource, such as a fishery, on reducing equality much more widely in a society should not be underestimated.

6.2.10.1 Biodiversity

There are a number of arguments favouring equal access, efficiency-constrained management as affording a better framework to preserve biodiversity and minimise the impact of fishing on natural ecosystems. Wilson *et al.* (1994) make a convincing case that fishing regulated by how, when and where fishing takes place is more likely to be effective because it is more compatible with the dynamics of ecological systems than management in which conservation relies on a TAC and quota, based on imperfect stock assessment and population modeling.

Even the argument that under a property rights management regime there will be an incentive to allow lobster stocks to increase and to maintain the population at a high level, on the grounds that this leads to increased catch efficiency and larger profits, may not be ecologically sound. Too many lobster may have as deleterious an effect on the ecology of reef habitats as too few. Prior to European settlement, Tasmania's coastal waters were inhabited by large numbers of seals, and the Australian fur seal is a predator of rock lobster (Strahan 1983: 462). In the past, seals possibly exerted a greater predatory pressure on rock lobster stocks. The current seal populations of 20 000 to 25 000 animals (Strahan 1983: 462) could take the equivalent of the total allowable commercial catch of approximately 1500 tonnes (DPIF 1997a: 5), which amounts to about 2 million lobsters per year, if each seal took only two lobster per week. It is possible that a reduction in seal numbers by early European hunters unleashed an ecological plague of lobster in Tasmania's coastal habitats, a plague that was nevertheless a welcome economic boon to lobster fishers.

There are many examples of the devastating ecological effects of removing high level predators from ecosystems. Savory (1988: 42-43, 247-266) links the disappearance of top level predators from many of the world's rangeland habitats to changes in the behaviour of grazing animals, that disrupt plant succession and change water cycles, eventually leading to desertification. He argues that the "behavioural response" of grazing animals to predators is critical to maintaining healthy systems. Current lobster

populations may not be "normal" or depressed by overfishing, but may in fact be far greater than the populations that existed prior to European arrival, when high levels of predation by seals may have been a limiting factor.

Rock lobster biology may include factors that lend credence to this theory. The suggestion that lobsters only require fairly small residual populations to provide adequate recruitment and are very robust in sustaining heavy fishing pressure, suggests that they may be adapted to withstanding high levels of predation. One could speculate on the environmental benefits of extensive harvesting of rock lobster in areas where seals are no longer abundant in order to re-establish a healthy ecological balance. Because the behavioural effect of predation may be important, it might be more appropriate to harvest lobster in ways that mimic seal predation, such as by divers using compressed air, rather than with the traditional baited pots. There may be significantly different evolutionary pressures exerted on a lobster population by a method of fishing that targets the hungry rather than one that targets the slow or incautious or those that lose in the competition with their fellows for access to the most secure hiding places.

The restoration, or at least replacement, of a process that mimics as closely as possible the predatory function of seals in rock lobster population ecology, might best be achieved by encouraging an increase in the lobster dive fishery. Diving is used to capture lobsters by many Tasmanian recreational fishers and is a method of commercial fishing for many species of lobster that do not come to baited pots, such as in the Torres Strait and the Caribbean. However the idea of promoting increased dive fishing for lobster would be poorly received by the rock lobster fishing industry. Feeling is strong in the pot fishing industry that taking lobster with compressed air should be prohibited. Nor is the predatory role of seals on rock lobster populations widely promoted by those with an interest in the conservation of seals and an awareness of the political power of the fishing industry to counter perceived threats to their commercial interests.

We can only speculate on many aspects of rock lobster population ecology, which is likely to be complex, and involve food web interactions with several predators, including seals and octopus (which in turn may interact with each other) and with possible competitors for food, such as various species of crab. There has probably been considerable impact on the ecology of reef ecosystems that support lobster populations, from fishing and other activities and the reduction in seal numbers from historic levels. However, reducing fishing effort to allow stock rebuilding and improved profitability is likely to have some ecosystem benefits, as it will entail less use of baitfish and less physical disturbance of habitat.

6.2.10.2 Economic Efficiency

Managing the fishery for efficiency in terms of maximising the production of resource rent does not necessarily lead to more efficient use of the resource (in a more holistic sense) than would occur if the fishery were managed for equal access and rent dissipation. The productive capacity of the rock lobster fishery is limited by biological constraints. Leaving aside the possibility of increasing the value of this productivity by using it in ways that yield greater well-being benefits in addition to its commodity value, and assuming the commodity value is the same whether it is harvested by a property rights, rent maximising fishery or by an equal access rent dissipating or redistributing one, what then is the net benefit to society of greater economic efficiency in terms of revenue production? It will not increase the production of wealth, and rent not dissipated in wages in a labour-intensive, efficiency-constrained fishery, can instead be dissipated in profits and rents in a property rights, revenue appropriating fishery.

A basic concept of economic theory is that efficiency is maximised when competitive forces can operate. Property rights is about preventing competition by enclosing resources, and this is what makes the consolidation and appropriation of resource rent possible. If one were really concerned about harvesting a sustainable catch of lobster as efficiently as possible, it might make sense to open the fishery to competition. There are over 8000 licensed recreational fishers each season. They are prevented by law from making any economic return from their recreational fishing. If regulations were changed to allow them to operate more efficiently, perhaps to use more gear, catch more lobsters, and sell them legally, and assuming their costs are offset by the non-material benefits they obtain from the enjoyment of fishing, then it may be that society could harvest the sustainable total allowable catch of lobster for practically no net cost at all, and thereby save the costs currently incurred to run and maintain the commercial lobster fleet.

Society may not be better off economically as a result of managing the fishery for rent production where this relies on enclosure, and this may be true even without considering the issues of well-being benefits, and of the potential for wealth dissipation from the region. A significant economic effect of managing to produce rent is the distribution of the wealth produced in the fishery away from people who work in the fishery and away from their communities, to the capital based property owners of the fishery and ultimately into the pool of global capital. If someone buys into the fishery and borrows money from a bank, that money does not necessarily belong to local savers; it is part of the global movement of money. Money flows freely from one bank to another across national borders from where it is made to where it can earn the highest return, or where it is most in demand. Money is borrowed out of the pool of global capital, and the interest is paid back into it. This interest is the economic rent from the fishery. If this amounts to half the value of the lobster produced, then this is the proportion of the

wealth from the resource that is potentially lost from the local community, and, in fact, largely from the wider Australian community.

The same effect occurs even if the money is not borrowed. A long time licence holder, who, through reduced constraints on fishing efficiency can obtain increased resource rent, may invest the income in a local bank; but from here it goes anywhere in the world according to demand. In the public consultation stage of developing the management plan for the rock lobster fishery, a frequently expressed concern was the fear that the fishery could be taken over by foreign investors (DPIF 1997d: 12). The report conceded that investment might be attracted to the fishery if it provided a good return. This preoccupation with foreign over local ownership misses the point. In a global economy it simply does not matter. Surplus wealth generated from the fishery can go anywhere in the world, just as wealth from anywhere in the world can buy control over part of the industry. The only wealth from the fishery that can be confidently retained, at least in the first instance, is that portion that is "dissipated" in local content fishing costs. Economic analysis that discounts these and believes that the profit, rent or surplus represents the only valid measure of the economic benefit from the fishery is misguided. This economic surplus is the part that may most readily be lost to the community and flow into the pool of global capital.

One might suggest that parochial concern over the flow of wealth out of a region does not matter. From a global perspective one could argue that capital accumulated from Tasmania's rock lobster fishery, as a result of efficient practices that prevent it being dissipated in wages to local fishermen, can provide the economic basis for the creation of jobs elsewhere. For example, resource rent gained by licence holders might be used to purchase a condominium in Queensland or an automobile manufactured in Germany, thereby creating employment for builders in Port Douglas or auto-workers in Stuttgart. But would these jobs contribute to sustaining the ecological integrity and the productivity of Tasmania's fisheries? It is unlikely that a builder in North Queensland or an auto-worker in Germany would see the link of dependency between their own economic well-being and the sustained ecological health and productivity of the fishery, as clearly as would an artisanal fisherman living in a coastal community in Tasmania in direct and close proximity to it.

While the foregoing argument focuses on concerns about the siphoning of wealth out of the community - this may not be as important an issue as the effect of promoting wealth inequality within it. The Draft Management Plan for Tasmania's abalone fishery, a fishery that produces very high rent for quota holders due to a high product value and low production costs, suggests that much of the economic surplus is reinvested locally (DPIF 1997b: 66). Perhaps this reinvestment creates jobs and provides a mechanism for

wealth accumulated in the fishery to be redistributed back into the community. Where capital is used to provide material things, tools or technological aids that create employment and production that would otherwise not occur, wealth may be generated and some of this may flow through wages into the local community contributing to its prosperity. But where investment amounts to nothing more than buying-up local resources, productive land for example, it may push up the price and thereby raise or sustain the capital value of these resources. This may do little for the economic well-being of many in the community. Raising the price of land may simply raise the barriers of enclosure against the local poor, reducing their options and entrenching their dependence on wage labour. This situation may not generate a spirit of conservation in a local community. Jealousy and resentment are natural human responses to inequality. Local people may perceive that maintaining the health and productivity of the local abalone and rock lobster populations, far from contributing to their own economic well-being, actually sustains the economic mechanisms that disempower and disadvantage them. They would have no incentive to protect the resource. Many in the community might be better off if the source of surplus wealth that contributed to maintaining inequality in the community, to their disadvantage, was no longer productive. It might be to their benefit if poaching redistributed the wealth more evenly in the community, or if overfishing or environmental deterioration reduced the production of surplus wealth from the fishery. The poor may benefit from deterioration in the productivity of the fishery, and the capitalised elite, which relies for the maintenance of its power, privilege and position on the immediate production of revenue from the fishery, cannot afford to compromise that immediate production in the interests of other values or indeed of future production. Such a situation is not conducive to maintaining, throughout the community, a commitment to ecologically sustainable resource management.

Management of Tasmania's rock lobster and other high value fisheries by enclosure through limited entry licensing, individual transferable quota and other property rights mechanisms, is not likely to maximise socio-economic benefits from the fishery. It is in fact likely to result in inefficient resource use if a holistic measure of efficiency is taken, a measure that includes consideration of all costs and benefits, not just financial inputs and outputs from the perspective of capital owners. This management approach also compromises many other values of ecologically sustainable development. Why then, did Tasmania adopt it instead of management based on a commitment to equality of access and conservation through efficiency constraint?

6.3 MAINTAINING THE SOCIAL ORDER

Leftwich (1983: 200-258) argues that the principal determinant of the way societies use resources and control access to them, is the maintenance of the stratification of power;

in other words, to maintain inequality. Drummond and Symes (1996: 155) essentially make the same claim, that:

In capitalist societies, 'regulation' has been and remains primarily concerned to maintain and control the value of capital and fixed assets and to preserve existing power structures within society.

Schumacher (1973: 59-60) points out that while the poor do not need the rich and may in fact be better off without them, the rich need the poor. Their power and privilege depend on maintaining an exploitative relationship with the poor, and to maintain power over them, the rich need to ensure that the poor remain poor. While it is important for the rich to have access to resources in order to maintain their wealth, it is equally critical for them to prevent the poor from gaining access to resources because, should they gain in wealth, power and independence, they thereby obtain the means to evade exploitation.

Managing resources to sustain capital is not about managing to maximise the economic well-being of the community. It is about maximising the economic power of the capitalised elite, maintaining their store of power, the value of capital assets, and their flow of power through production of revenue, and this is relative to, and dependent on, limiting the economic well-being of the rest of the community. Enclosure is the means of preventing the poor from evading exploitation through economic independence achieved by gaining access to resources. As long as the monopoly enjoyed by the few over capital inputs in productive processes (including fishing) is sufficient to maintain their relative advantage, the status quo is unchallenged. But when the economic viability of capital intensive fishing is threatened, either by ecological limits, or competition from labour intensive and possibly more efficient methods, capital requires financial or environmental subsidies or it has to respond with enclosure and the establishment of property rights. Monopoly is resorted to when capital cannot compete with labour's production costs. The greater the deprivation of the poor, the lower their opportunity cost of labour, and the more competitive they become relative to capital, thus necessitating enclosure to protect capital interests.

Boyce (1996) describes how in Tasmania the precedent of maintaining social control through exclusion from resources was set in the early years of European settlement. Kangaroo meat was of vital importance to the survival of the European settlements in Van Diemens Land. In the early 1800s the abundance of kangaroo provided for the well-being of the settlements but was a threat to the maintenance of social order. Boyce (1996: 42) describes the concern of the administration over the "enormous social implications of this free food", and attempts by the establishment to manage the situation so that:

Kangaroo could remain the equivalent of English game - the exclusive property of the privileged classes - through restricting dog ownership and keeping demand low. Otherwise, as he rightly foresaw, the basic means of survival and source of wealth would not be privately owned, but freely available to all, and the whole system of social control and order, the foundation of privilege and power, would thus be undermined.

At first the imperatives for maintaining social order had to be compromised in order to provide for the survival needs of the community in the critical early years. Boyce points out that in the years 1806-1808 most of the population of Hobart were involved in hunting to some extent. Convicts were armed and provided with dogs and enjoyed a considerable degree of freedom, independence and access to the means of wealth.

A consequence of this economic freedom, this access to resources, was a scarcity of exploitable labour for the development of capital on the land holdings. Commentators complained about the general idleness of the population which, sustained by access to the bounty of natural resources, did not find itself compelled to work at cultivation of the land for the benefit of the higher social orders who had acquired ownership of it (Boyce 1996).

Once the settlement was securely established this threat to social and political order was addressed. In 1817 Lieutenant Governor Davey attacked the economic independence of Van Demonians by banning commerce in kangaroo meat and ordering the destruction of dogs. Development of Tasmania's vast grazing lands for sheep and profit was encouraged. Enormous land grants were made to wealthy new immigrants in proportion to the capital they already possessed, and a period of repression which lasted for several decades re-established British Government authority over the land resources and people of Tasmania (Boyce 1996). Control over the wealth and resources of Tasmania was appropriated by a group of about 500 powerful, privileged, wealthy men and it has been retained in relatively few hands to this day (Boyce 1996). It is logical to assume, with the support of Leftwich's (1983) analysis of the politics of resource use, that this group would ensure that Tasmania's resources continue to be used in ways that perpetuate their hold on power.

In Tasmania enclosure of the valuable rock lobster and abalone fisheries was largely achieved with the introduction of limited entry in the late 1960s. Over the following decades efficiency creep, through the introduction of new technology, has allowed the production of greater amounts of economic surplus from the fishery, resulting in an increase in the capital value of licences. Management options presented in 1997 all favoured further concessions to efficiency, necessitating tighter regulation, reducing the

distribution of wealth to labour and thereby increasing the capital value of the licences that provide privileged access to the fishery.

Tasmania's fisheries are managed for a mix of commercial and recreational purposes. The thrust of management has been, and continues to be, to allow increased profit to capital by the establishment of property rights and reduced access to the resource by ordinary people. Certainly people can buy a recreational licence but this does not allow access in ways that would allow them to gain some of the wealth of the resource. The constraints are such that those who take up their right of access through purchase of recreational licences can only do so as consumers under economically unviable conditions. They may not legally sell their catch and regulations and penalties are severe.

Leftwich (1983), Drummond and Symes (1996) and others have argued that furthering the cause of capital is incompatible with ecologically sustainable outcomes. The approach to management for profit on the one hand and exclusion on the other, may therefore contradict the requirements for ecological sustainability, though it may claim moral legitimacy by donning the environmental mantle and using it to obscure what are essentially political objectives. Conservation-oriented organisations may unwittingly contribute to this process by consenting to what they see as a reasonable compromise, the restraint on exploitation of nature by people on the one hand, through exclusion and enclosure mechanisms, and acquiescence to the granting of licence for capital and privileged individuals to maximise profit in the name of efficiency on the other.

Putnam (1993) compared democratically functional and dysfunctional regions of Italy. He demonstrated clear links between functional democracy and the achievement within a society of quality of life parameters, civic values, economic prosperity and general well-being, and a corresponding link between civic dysfunction and vertical power structures, patron-client relationships, and the failure of democratic institutions of government. Putnam (1993: 123-157) also demonstrated that the traditions of democratic functionality and civic culture, and those of undemocratic, feudal, patron-client cultures could be traced back many centuries in his Italian case studies, demonstrating the persistence of established power structures and social characteristics over many generations.

Tasmanian historian, John Young (1995), used Putnam's analysis of the factors involved in sustaining a civic society and those that contribute to civic dysfunction to draw a comparison between Tasmania and Calabria, a region in Italy that Putnam (1993: 135,154) described as dysfunctional, characterised by corruption, a lack of civic culture, economic failure and, incidentally, a preoccupation with property rights. Hay (1977)

noted an absence of civic commitment in Tasmanian politics and a culture characterised by corruption and patronage. He noted that behaviour which in other parts of the world would be regarded as flagrant corruption was, in Tasmania, regarded as the normal way of doing business or conducting public affairs. So entrenched were such practices that they were not recognised as wrongdoing by participants, nor did Tasmania's democratic institutions function effectively to censure them.

Young and Hay have demonstrated a history of a culture of clientalism in a number of Tasmanian industries, notably the fruit and timber industries, and Young argues that managing these resources to serve the interests of privileged monopoly holders has contributed to the poor performance of Tasmania's economy, despite the island state's abundant resource wealth. Young argued that the lack of a democratically functional, civic society has stood in the way of the Tasmanian community managing timber resources so as to optimise the production of economic benefits and well-being benefits across the wider Tasmanian community.

Boyce (1996) has described the establishment of feudal-like power structures in Tasmanian society during the early years of colonial settlement and the persistence of these structures to the present day. As we have seen, Boyce demonstrated the preoccupation with maintaining social order that dictated policy regarding wild game resources during the early years of settlement in Tasmania, a priority that prevented the community from legally enjoying the potential economic benefits that could have resulted from a less politically constrained approach.

Given the foregoing analysis, it would be reasonable to expect contemporary management of valuable Tasmanian fisheries resources to follow a similar pattern and serve the same sort of political objectives, though perhaps less blatantly, as those that influenced regulation of kangaroo resources in the early 1800s. One would expect to see the perpetuation of the established pattern of privileged, monopoly control of access to valuable resources such as fisheries. Palsson and Helgason (1996: 47) point out the feudal characteristics of fisheries managed with individually transferable quota in which quota holders have become *de facto* owners of the resource. Tasmania has implemented management based on tradable quota for its high value abalone and rock lobster fisheries, which has, with the exception of recreational access provisions, enclosed and privatised them.

This is not a consequence of a Machiavellian conspiracy involving resource managers. Resource managers are bound to operate within the framework of established vested interests. In a society bound by a feudal pattern of distribution of political power and property, maintained by established legal precedents and encultured social expectations,

the perpetuation of feudal practices of resource use and distribution is to be expected. The development of management regulation of fisheries since European settlement did not occur as the result of any particular plan, but by an evolutionary process of adapting to changing circumstances, but always constrained by the characteristics, and particularly the interests of the power structures, of Tasmanian society.

It might be argued that the environment is better protected in a feudal backwater than in a more affluent society. The lack of economic development and cultural sophistication, perhaps due to its socio-political characteristics, is the source of much of Tasmania's charm as a place to visit or live. Those whose status allows them to enjoy the privileges, rather than bear the social and economic burdens of inequality, would likely favour the perpetuation of the established social order and patterns of resource use that maintain it. There is a subjective element to the issue, but if objectivity is required it can be found in consideration of the issue against the defining criteria for ecologically sustainable development as previously discussed.

An obituary for Mancur Olson in *The Economist*, (Anon. 1998), summarised his contribution to economics. In *The Rise and Decline of Nations* Olson brought politics and economics together. Olson pointed out that special interest groups have an advantage over those with a broader interest in the well-being of society as a whole. He theorised that over time in any society, vested interest groups, usually with government help, accumulate privileges and monopolies. This distorts economies, which are further weakened as more and more resources flow to a management class of lawyers, bureaucrats and lobbyists involved in redistributive activities rather than productive ones. Economic decline is entrenched as resources are monopolised by a self-serving governing class. Catastrophe appears to be the cure for the condition; war or revolution (or possibly economic collapse) that sweeps aside the established pressure groups and the established social order. Alternatively, Olson theorised, a nation's people could avoid the dangers of parochialism if they were recognised and countered with sound institutions and policies. Saul (1997: 152,158-195) expresses a similar view, that only citizen-based, participatory decision making can avert the economic and social decline that corporatist management and the serving of vested interests without regard to the public good produces in society. But as Putnam pointed out, sound institutions and policies are a characteristic of civic, egalitarian societies. These values are undermined by concentrated power, so the process is disequilibrating.

Tasmania's population is declining due to emigration by people frustrated by the lack of economic opportunities. A cargo cult mentality is developing as Government searches for economic salvation by attempting to attract tourists, retirees and investors to the state. Net emigration may serve to diffuse the social pressures that might otherwise

pose a threat to existing relations of social and economic power, but it drains Tasmania of resources and deepens its economic problems. This makes Government more desperate for revenue producing outcomes from resource management at the expense of social and environmental values, thus perpetuating the downward spiral. The introduction of revenue generating management of fisheries is both a cause and a consequence of this, and it has implications for the issue of ecological sustainability. For example, it may be linked to the Tasmanian Government's preoccupation with increasing the extent of aquaculture development in the state, particularly intensive salmon production which may not be environmentally (Mace 1997: 18), or economically (Folke, Kautsky and Troell 1994) sustainable, and also has significant social impacts (Gowen 1991: 39-40). As these and other measures further heighten social tensions and general dissatisfaction with government, centralised power comes increasingly under threat from democratic process. If vested interests are to be protected, these democratic threats must be countered. Changes made to the electoral process by dual consent of the major parties in Tasmania in 1998, in which the number of representatives in the Lower House was reduced from 35 to 25, have been criticised as a cynical attempt to subvert and permanently undermine the democratic processes in order to retain a narrow access to power (Peter Hay pers. comm. 1998). Undermining democratic processes may have direct implications to sustaining fisheries in Tasmania. It may for example, reduce the prospects of establishing a meaningful network of marine reserves in Tasmania, arguably the most effective way to protect marine ecosystems and fisheries (Ballantyne 1997; Watson 1997). Ballantyne (1997) concedes that the establishment of marine reserves requires functional democratic decision making processes and, one might add, a civic culture, in order to promote the public interest over the vested interests of the fishing industry. All of these environmental, political and economic matters are interlinked. In regard to management of Tasmanian fisheries, management that serves stakeholder interests over the interests of the wider public, that reduces employment and opportunity and consolidates wealth and power in few hands, does not contribute to progress towards the development of an ecologically sustainable Tasmanian society.

7. DISCUSSION

7.1 INCOMPATIBILITY OF CAPITALISM AND ECOLOGICAL SUSTAINABILITY

As we have seen, numerous writers have demonstrated the contradictions between the imperatives of capitalism and the requirements for a society to achieve a sustainable existence. Drummond and Symes (1996) have discussed this in relation to fisheries management. They argue that capitalism is not an equilibrating process and that the pressures generated by the accumulation imperatives of capitalism are the fundamental causes of the failure to manage fisheries sustainably. Recognising that 'regulation' in capitalist societies is primarily concerned to "maintain and control the value of capital and fixed assets and to preserve existing power structures within society", Drummond and Symes point out that the consequences of inherently unsustainable socio-economic arrangements can be deferred and the expression of economic dysfunction postponed, but usually at the cost of undermining the social and ecological fabric of sustainability (Drummond and Symes 1996: 157). The managerial response to crisis is to consider only those strategy options that preserve the value of capital and existing patterns of social relations. These strategies are legitimised while those that would undermine existing power relations are invalidated. This inevitably results in unsustainable outcomes "because they necessarily involve the progressively severe exploitation of both natural capital and certain segments of society" (Drummond and Symes 1996: 156). These managerial strategies are 'non-solutions' and Drummond and Symes include management by individual transferable quotas and the application of privatised property rights to fishery resources in this category, because they involve potentially unsustainable social outcomes.

Management of fisheries according to the principles of equality of access and conservation through inefficiency, as advocated in this thesis, unavoidably compromises the political imperatives of capitalism. By linking the issues of distribution and conservation, and stressing the importance of equality and the idea that, in the long run, conservation of resources depends to a great extent on how access to them is distributed, the equal-access paradigm contradicts the widely held position among resource managers; that conservation is a purely technical matter, that allocation is an entirely separate social or political matter, and that the two issues have no bearing on each other. This equal-access model might also be seen to contain a political dimension in that it advocates equality of access and sharing of resources. It is possible that the conservation argument could be used to serve the political goal of gaining access to resources by the have-nots in society.

The enclosure paradigm for resource management is also essentially political. It is an ideology that serves vested interests. As it advocates private ownership and management of natural resources as property, it serves the interests of capitalised elites, those with the power to secure ownership. The paradigm serves to legitimise the practice of resource appropriation by the powerful. In entrenching inequality of access to resources it promotes and maintains a wider inequality in the distribution of wealth and power. It attempts to legitimise management for inequality by claiming that this is the only way to achieve environmental sustainability and therefore serves the common good. Once again the conservation issue may be serving a political agenda rather than *vice versa*.

If the equal-access/efficiency-constraint model for fishery management is compared with the model based on property rights and enclosure against the criteria listed in chapter 1 as defining and constituting ecologically sustainable fisheries management, the equal access model seems preferable. The equal access model is the only one that satisfies the criteria of intragenerational equity and arguably best meets the efficiency criteria as discussed in chapter 5. If one considers that the generally accepted fundamental causes of biological and social fisheries failure are overcapitalisation, overuse of damaging harvesting technologies and the accompanying displacement of labour, all consequences of too great a tendency to support capitalised vested interests against the interests of the common good, then the equal-access/efficiency-constraint approach offers solutions, while privatisation, enclosure and management for revenue maximisation is only likely to perpetuate the problems.

However, the enclosure model is the one that serves the vested interests of capital, of financial institutions, of government bureaucracies and those who serve in them, and of the politically influential sector of the current generation of fishermen who benefit from the one-off transfer of public wealth into private hands - everyone, in fact, with any power to influence management decision making.

7.2 SUSTAINING CAPITAL

Fisheries management agencies are generally instruments of the state. Capitalist values are integral to the state, which gains the financial resources required for its maintenance from the portion of the surplus of economic activity in the society it controls; that it is able to appropriate. The "state" as an institution is as dependent for survival and maintenance of its power on the production of surplus from economic activity as capital is dependent on the production of profit. This is why it is imperative for instruments of the state and the individuals who serve in them to manage resources so as to produce revenue or financial surplus. They are co-dependent with capital on managing resources as accumulation systems, of managing for profit and resource rent. But if managing for

capital is incompatible with managing for ecological sustainability, how do resource managers serve the former purpose while believing they are serving the latter? By what mechanisms do they ignore the contradictions that face them and keep faith in the myths that justify the ideology of enclosure and so continue to believe that enclosure mechanisms serve the public interest and the values of ESD?

Capital-serving thinking is maintained by the culture of institutions. Saul (1997: 76-116) and Leftwich (1983) point out how effectively divergent views are censored and conformity of view developed and maintained within institutions. Individuals either adapt their views, consciously or unconsciously, according to the requirements for career advancement, or they stagnate or are weeded out of the system.

Ward and Weeks' (1994) study into the attitudes of employees of a State Fisheries agency demonstrated a remarkable consistency in their subjects' views regarding conservation and allocation of access to fisheries resources. They (1994: 101) found that a group of state-employed fisheries biologists and managers, almost without exception, held a common belief that without regulation, fishers "will take what they can until they can't take anymore", and; "will fish until the last fish is caught", and; "will take every last living one".

This is remarkable because in the particular oyster fishery that was the focus of the study, depletion by over fishing was simply not a factor that significantly affected recruitment to the oyster population. Environmental factors that were beyond the control of regulators and fishers alike were the primary factors that influenced reproductive success, future productivity, and long term sustainability of the fishery. The biologists involved in the study were aware that fishing-related depletion did not affect future productivity and was not a factor in long term sustainability. Yet, with only one exception, they articulated a "tragedy of the commons" paradigm as the framework of their understanding of the interaction of human nature and fisheries. Their faith in a belief system that was contradicted by their own scientific observation, but sustained by the doctrines of their profession, indicates an ideological basis for their views, rather than a rational one based on fact, truth and science.

Their ideology is based on a myth, a subtle misinterpretation of the *economic principles of sustainable resource management*. It is an ideology so widely held that it is considered "public knowledge" (Ward and Weeks 1994: 98). It is part of the collective, cultural knowledge of fishery managers and is instilled as part of the training of resource management professionals. This ideology can justify enclosure on the erroneous grounds that it is necessary to provide biological sustainability, and in so doing, establishes privileged access to resources. Fisheries managers are often deluding

themselves when they believe that they are conserving the resource. They may in fact merely be managing and policing allocation and access to the wealth of natural resources to serve socio/political interests.

If the first pillar of support for the ideology of enclosure in fisheries management is belief in the inevitability of "tragedy of the commons" outcomes if everyone had "open access" to them, then the second is the belief that enclosure is necessary to manage resources for "economic efficiency" and that this particular view of "efficiency" is in the public interest. This belief rests on a view of efficiency from the perspective of production of revenue, economic surplus or resource rent. However, the view that the economic surplus produced from use of fisheries resources is the only net economic benefit produced is not valid if a holistic view of efficiency is taken. It does not measure the economic well-being benefits to a community, only the potential for one part of the community to gain economic advantage over another through the generation and appropriation of revenue.

Few fisheries managers are aware of the full extent of the contradictions of the situation in which they operate. Indeed many would insist that their only objective, or guiding brief, is to achieve sustainable outcomes from fisheries management, and that they have no brief for or interest in serving capital. In this they fail to recognise or acknowledge the primary purpose that is served by the way resources are managed. They are unaware of the essentially political purpose that is the foremost goal of resource management. This political purpose is so hidden within values that are deeply entrenched in individuals and in social institutions that it is served without questioning its purpose or effect. We do not always recognise the political purpose of these values, (that is, their function in maintaining established power structures in society), because this purpose is generally obscured. The political position behind expressed ideals such as "encouraging investment" and protecting stakeholder interests is not always apparent.

In order to continue to serve the interests of the politically powerful in comfortable ignorance of the contradictions between the expressed goals of resource management agencies and the actual outcomes of the resource management functions to which they contribute, resource managers need only to believe that issues of resource allocation and resource conservation are separate; that social and ecological issues are unrelated; and that economic efficiency is independent of social questions of allocation. Current trends in resource management go further and suggest that there is a regressive correlation between social equality and conservation, that the unfairness and inequality that inevitably seems to accompany resource enclosure, is unavoidable if conservation and economic efficiency is to be achieved.

7.3 IS SUSTAINING CAPITAL MORE IMPORTANT THAN ESD

The social commitment to sustaining the value of capital and capital assets as the measure of power and status is deeply entrenched. Many are dependent on the state for financial support and security. Government employees and pensioners do not gain a living through direct extraction or processing of natural resources. Their incomes are dependent on the revenue that governments can extract from more primarily productive enterprises. Their interests may seem better served by managing resources for efficiency in revenue production rather than for the well-being of participants. Their relative positions and privileges in society may seem to be best maintained relative to those of workers in the primary producing sectors, if existing inequities are maintained by controlling access to resources. They have a vested interest that is served by managing through a combination of revenue maximisation and exclusion.

Nor are they alone. Almost everyone is dependent for financial well-being on sustaining the value of financial capital. Ordinary people have savings, pension funds and investments of various kinds. They will support measures that sustain the value of their capital to provide for their future needs even though such measures disproportionately favour the capitalised elites. If the price of equality is the loss of personal economic security, it is too high a price to pay.

But if failing to restrain capital results in wasteful and destructive use of resources it will inevitably lead to social and ecological collapse. Economic security will be lost from trying too hard to maintain it in a misguided manner and thereby failing to understand the real source of economic security, which is a healthy, productive environment and a healthy, cohesive society. The recent collapse of the Indonesian economy provides an illustration of this. In the economic boom, people may have enjoyed the cash benefits of development and accepted the accompanying growth of inequality in wealth and power in their society. They may have accepted the destruction of their forests and their fisheries. But when the system collapsed, as unsustainable systems inevitably must, their money was worth little. Their savings and pensions and investments could not buy the food they needed to survive, and their forests which had been cut down, their oceans which had been polluted and overfished, and their fields which had been turned into golf courses and office buildings, could no longer provide it.

All are affected but those that benefited most from the growth in inequality may retain their relative advantage. They may retain their positions of status and power relative to others in the community and relative status may be more important to individuals than sustaining environmental well-being for all. As Milton observed in *Paradise Lost*: "Better to reign in Hell, than serve in Heaven"; a sentiment supported by Ardrey's observation (1961: 105) that: "Rank must come first in the preoccupation of any social

animal, for rank tells all". Status within society takes a higher priority for the individual than the well-being of the group as a whole. Where capital is the basis of status, all individuals will defend their capital interests first, and where this is incompatible with environmental sustainability, then the environment suffers. This is the tragedy of the commons.

But Leopold (1949: 203) observed:

All ethics so far evolved rest upon a single premise: that the individual is a member of a community of interdependent parts. His instincts prompt him to compete for his place in that community, but his ethics prompt him also to co-operate (perhaps in order that there may be a place to compete for).

With regard to ecologically sustainable fisheries, if the common good is to be promoted, then the selfish instincts that underlie the service of capital need to be balanced or countered by more ethically based mechanisms and strategies for fisheries resource use.

There are two aspects to ensuring that there is a place to compete for. One is to ensure that the group does not destroy this place themselves by dysfunctional, unsustainable practices of resource use. The other is to ensure that their communal place is not taken away by others. Both of these eventualities are best countered by a cohesive society with a sense of shared interests to protect.

A different strategy for group success might be postulated, based on consuming resources and growing as quickly as possible in order to be able to outcompete and displace neighbours, and thus assume control over the neighbours' resources. Such a strategy is not without precedent, as described by Diamond (1997: 53-57) in relation to the conquest of the Chatham Island Moriori people by their Maori cousins in the 1830s. The Moriori had been isolated for a thousand years in the Chatham Islands, 500 miles from New Zealand's North Island, and had developed an ecologically sustainable society. Their waters were abundant with fish and seals and they were not a warlike people. As discussed in chapter 2, the Maori culture emphasised warfare and cannibalism and intense conflict over depleted resources. When the Maori learned from western navigators of the circumstances of the Chatham Islanders, 900 of them obtained passage to the islands, which they took possession of from 2000 Moriori inhabitants who were then killed and consumed. This example does not serve to promote the cause of ecological sustainability. But as Diamond points out, the cause of the Moriori defeat had much to do with naiveté caused by isolation.

Few societies live in isolation today. The global community is made up of groups within groups. There is a recognised need to extend ethical considerations to a wider

global community. Unrestrained capitalism does not have an ethical basis, nor does managing resources by enclosure if this allows wasteful use and resource destruction. Exclusion of others from resources to allow unrestrained access by some, rather than an approach that emphasises mutual self restraint, is equally devoid of an ethical basis. Ethnic cleansing and genocide are, after all, only an extension of this approach. Managing resources by the equal access approach however, can be effective in conserving social and natural resources, and it has a defensible moral basis in which ethical consideration is not restricted to a small privileged group but extended to a wider community.

Much of the argument of this thesis may be seen as an unbalanced attack on capitalism, and it is conceded that the motivation of capitalism has brought many well-being benefits to mankind. These growth imperatives are perhaps simply an extension of the competitive growth imperatives that drive the continuing evolution of life on this planet. Plants within communities compete for resources. They grow, crowd and overshadow their neighbours and attempt to monopolise resources and starve potential competitors, because if they do not win in the race for resources, they will be starved themselves.

The instincts that drive capitalism are too deep seated to be banished. What is needed is some balance to curb the progression of the disequilibrating processes of capitalism in order to maintain some stability and continuity, some sustaining of particular, desirable social and ecological circumstances. Without constraints, capitalism can develop to the extremes of crony or feudal capitalism with adverse social, economic and environmental consequences. Democracy, which is inextricably linked with equality, is perhaps the only mechanism by which society can curb and balance capital's pursuit of self interest.

In order to promote equality societies need to manage some resources so that they contribute to wealth equalisation. Community resources that are managed for sustainability and according to the principle of equal access can contribute to wealth equalisation. Fisheries are a key resource in this regard because historically they have not been so completely subject to enclosure and monopolisation as have many other resources. This situation, however, has been changing with the promotion of "property rights" management regimes around the world in recent years.

In many circumstances fisheries managed as "commons" can better provide for the social and economic needs of people, the structural economic needs of communities, and the environmental requirements for sustainability, than fisheries managed by enclosure for profit. If societies are to enjoy the benefits of fisheries as commons they need to face up to the challenges of how to retain and manage fisheries sustainably as

commons with equalising efficiency restraints, and how to regain commons that have been enclosed.

8. CONCLUSION

By their nature most fisheries are natural commons. This factor has been widely viewed as an obstacle in the way of achieving a sustainable relationship between fishery resources and those who exploit them. We have developed the technology that provides the means to exploit fisheries at unsustainable levels, and economic, social and market structures that motivate unsustainable practices by rewarding those who participate in these activities. As a result, tragedy of the commons explanations for fisheries decline and collapse are widely held, and enclosure or privatisation is promoted as the solution. This approach is often espoused by industry and government as it entrenches a situation of privileged access to resources and avoids the need to confront established and powerful vested interest groups. However it also involves abdication of government responsibility to properly manage the resource on behalf of the public, the nominal owners. It does not prevent people's interests being compromised, it merely removes their rights of opposition.

There are other flaws to the privatisation approach. For one thing it undermines a significant value of ESD - social equity. Dispossessing the majority of the community of an interest in the resource can alienate what is potentially the most significant force for achieving sustainable outcomes and resource conservation. Indeed, contrary to the theory that privatisation will create an incentive for conservation, there are, in practice, apparently sound financial arguments for owners of enclosed fisheries to manage them in ways that are unsustainable but which maximise the economic potential of the resource, when such factors as risk, spillovers and financial discounting are taken into account.

The real underlying cause of overfishing may not be common access but the emphasis on maximising financial returns from the resource for political reasons, and from the failure of many other values relating to ESD to carry sufficient weight in the decision making process. The emphasis on economic returns to the exclusion of other values leads to very inefficient use of our resources. The contribution that fisheries can make to the well-being of society cannot be realised as long as the bias in favour of commodity and financial value is maintained. We have reached or exceeded the maximum sustainable level of commodity production from many of the world's fisheries. The only way of increasing the contribution these resources make to individual and social well-being is to give greater emphasis to the non-commodity contributions they can make. If other values are to be emphasised this may be at the expense of the financial efficiency of commodity production as seen from the level of the firm, however, with creative management this may result in general and dispersed economic benefits to society as a whole. Should tangible economic benefits not

eventuate, the intangible contributions that sustainable management can make would more than compensate for lost material benefits and lead to a more socially efficient use of fishery resources.

Where successful fisheries exist on the basis of principles of decommodification and management for other values more closely reflecting ESD principles, they have often evolved by accident as a result of entrenched practices based on values of tradition or religion. Once these management systems are established and the economic and social benefits recognised, they are often maintained by strong community pressure.

Recreational fisheries can provide for values associated with maintaining cultural traditions, subsistence, maintenance of ecosystem integrity and economic benefits from activities such as tourism that are dependent on the health of the fishery. There is often a fine line between commercial exploitation and a non-commercial relationship with the resource. Opportunities may exist to develop the economic potential of many fisheries within the framework of other ESD values. Success in achieving this may often require mechanisms to protect the fishery from commodity market forces. Community based management and control and the application of a regional economic focus may contribute to successes in this regard. Perhaps the most important characteristic of recreational fisheries is that they are often managed as "commons" by equal access and efficiency constraint.

Once resources have been privatised it is often very difficult to reclaim them as commons. Pitcher (1998) describes three ratchets that obstruct fisheries rebuilding for sustainability. They are *Odum's ratchet*, relating to the difficulty of reversing ecological change, *Pauly's ratchet* relating to the scientific perception of "normality" in ecosystems, and *Ludwig's ratchet* which recognises the problem of the need to service loans invested in capital fishing assets that can often only be achieved by further investment in technology in order to boost efficiency. There is also a fourth socio/political ratchet to consider. This relates to the forces of resistance to challenges to the established social order. It might be possible to compensate private resource owners financially in order to restore fisheries as commons; for example, by paying Tasmanian rock lobster fishery licence holders the 150 million dollar value of their entitlements. If, however, the resource is then given to the public, there would be a downward distribution of wealth to those whose limited options would cause them to disproportionately benefit from equal access to this newly available resource. This would have spillover effects into other areas of the economy, strengthening the position of the underclass and be detrimental to the interests of the powerful. There are of course occasions when such revolutionary practices are politically acceptable, as in South Africa where the new government has attempted to redress past imbalances by

reallocating fisheries quota from corporate groups to people from disadvantaged communities (du Plessis and De Wet Schutte 1997; Hutton, Cochrane and Pitcher 1997).

Paradoxically, the economic collapse of fisheries may contribute to the prospects of establishing equal access to them. Once a fishery loses commercial viability it weakens the interests committed to retaining private control over it. It may then become politically possible for managers to introduce practices which foster conservation and other ESD values instead of commodity production.

People power may also contribute to maintaining or reclaiming fisheries as sustainably managed commons. The political power of recreational fishing, which has high participation levels, can influence fisheries management, and consumer choice may also be able to play a role. It is interesting to note Mace's report (1997: 8) that Greenpeace is campaigning aggressively against fisheries management based on private property rights in New Zealand and the United States, and that the World Wildlife Fund (Kemf *et al.*, cited by Mace 1997: 8) is opposed to management that involves private property rights in any fishery.

Globally, fishery management is at a crisis point. The established theories and practices are failing to produce satisfactory outcomes. The politically palatable (capital-serving) response of privatisation is not likely to halt fishery decline and it has serious social implications. It is also a path incompatible with ESD values. The only alternative, and one which offers exciting challenges to the profession, is to explore the possibility of achieving ESD outcomes by giving greater emphasis to non-commodity values in fishery management planning. This course will not be easy. It represents a major shift in the way fishery managers will have to operate. It will also have to confront powerful vested interests. The point at which this becomes politically feasible will vary. But ethical considerations point to it as the direction that we should take in order to achieve ecological sustainability of fisheries with all the values that this term implies.

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